Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquid Chemicals in Bulk

July 2017

Lloyd's Register

A guide to the Rules

and published requirements

Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquid Chemicals in Bulk

User's guide

These Rules incorporate the amendments of the IBC Code in full at the date of publication. For the purposes of classification with LR and assignment of the notations provided for in LR III, ships for liquid chemicals are required to comply with these Rules and the relevant provisions of LR's *Rules and Regulations for the Classification of Ships*. Classification requirements which are additional to the requirements of the IBC Code have been included as far as practicable in these Rules. All text which does not appear in the IBC Code and all paragraphs which do not appear in the Code are prefixed by 'LR'.

This guide shows the arrangement of contents in respect of Chapters. A comprehensive List of Contents is placed at the beginning of the Rules.

Rules updating

The Rules are published periodically and changed through a system of Notices between releases.

July 2017

PLEASE NOTE: No technical changes have been made to this Rule set, only the date has been updated.

Section 1
Background

1.1 Lloyd's Register Group Limited is a registered company under English law, with origins dating from 1760. It was established for the purpose of producing a faithful and accurate classification of merchant shipping. It now primarily produces classification Rules.

1.2 Classification services are delivered to clients by a number of other members subsidiaries and affiliates of Lloyd's Register Group Limited, including but not limited to: Lloyd's Register EMEA, Lloyd's Register Asia, Lloyd's Register North America, Inc., and Lloyd's Register Central and South America Limited. Lloyd's Register Group Limited, its subsidiaries and affiliates are hereinafter, individually and collectively, referred to as 'LR'.

Section 2
Governance

2.1 Lloyd's Register Group Limited is managed by a Board of Directors (hereinafter referred to as 'the Board').

The Board has:

appointed a Classification Committee and determined its powers and functions and authorised it to delegate certain of its powers to a Classification Executive and Devolved Classification Executives;

appointed Technical Committees and determined their powers, functions and duties.

2.2 LR has established National and Area Committees in the following:

Countries:	Areas:
Australia (via Lloyd's Register Asia)	Benelux (via Lloyd's Register EMEA)
Canada (via Lloyd's Register North America, Inc.)	Central America (via Lloyd's Register Central and South America Ltd)
China (via Lloyd's Register Asia)	Nordic Countries (via Lloyd's Register EMEA)
Egypt (via Lloyd's Register EMEA)	South Asia (via Lloyd's Register Asia)
Federal Republic of Germany (via Lloyd's Register EMEA)	Asian Shipowners (via Lloyd's Register Asia)
France (via Lloyd's Register EMEA)	Greece (via Lloyd's Register EMEA)
Italy (via Lloyd's Register EMEA)	
Japan (via Lloyd's Register Group Limited)	

New Zealand (via Lloyd's Register Asia)
Poland (via Lloyd's Register (Polska) Sp zoo)
Spain (via Lloyd's Register EMEA)
United States of America (via Lloyd's Register North America, Inc.)

Section 3
Technical Committee

3.1 LR's Technical Committee is at present composed of a maximum of 80 members which includes:

Ex officio members:

- Chairman and Chief Executive Officer of Lloyd's Register Group Limited
- Chairman of the Classification Committee of Lloyd's Register Group Limited

Members Nominated by:

- Technical Committee
- Professional bodies representing technical disciplines relevant to the industry
- National and International trade associations with competence relevant to technical issues related to LR's business

3.2 In addition to the foregoing:

(a) Each National or Area Committee may appoint a representative to attend meetings of the Technical Committee.

(b) A maximum of five further representatives from National Administrations may be co-opted to serve on the Technical Committee. Representatives from National Administrations may also be elected as members of the Technical Committee as Nominated Members

(c) Further persons may be co-opted to serve on the Technical Committee by the Technical Committee.

3.3 All elections are subject to confirmation by the Board.

3.4 The function of the Technical Committee is to consider:

(a) any technical issues connected with LR's business;

(b) any proposed alterations in the existing Rules;

(c) any new Rules for classification;

Where changes to the Rules are necessitated by mandatory implementation of International Conventions and Codes, or Common Rules, Unified Requirements and Interpretations adopted by the International Association of Classification Societies, these may be implemented by LR without consideration by the Technical Committee, although any such changes will be provided to the Technical Committee for information.

Where changes to the Rules are required by LR to enable existing technical requirements within the Rules to be recognised as Class Notations or Descriptive Notes, these may be implemented by LR without consideration by the Technical Committee, although any such changes will be provided to the Technical Committee for information.

3.5 The term of office of the Chairman and of all members of the Technical Committee is five years. Members may be re-elected to serve an additional term of office with the approval of the Board. The term of office of the Chairman may be extended with the approval of the Board.

3.6 In the case of continuous non-attendance of a member, the Technical Committee may withdraw membership.

3.7 Meetings of the Technical Committee are convened as often and at such times and places as is necessary, but there is to be at least one meeting in each year. Urgent matters may be considered by the Technical Committee by correspondence.

3.8 Any proposal involving any alteration in, or addition to the General Regulations, of Rules for Classification is subject to approval of the Board. All other proposals for additions to or alterations to the Rules for Classification other than the General Regulations, will following consideration and approval by the Technical Committee either at a meeting of the Technical Committee or by correspondence, be recommended to the Board for adoption.

3.9 The Technical Committee is empowered to:

(a) appoint sub-Committees or panels; and

(b) co-opt to the Technical Committee, or to its sub-Committees or panels, representatives of any organisation or industry or private individuals for the purpose of considering any particular problem.

Section 4
Naval Ship Technical Committee

4.1 LR's Naval Ship Technical Committee is at present composed of a maximum of 50 members and includes:

Ex officio members:

- Chairman and Chief Executive Officer of Lloyd's Register Group Limited

Member nominated by:

- Naval Ship Technical Committee;
- The Royal Navy and the UK Ministry of Defence;
- UK Shipbuilders, Ship Repairers and Defence Industry;
- Overseas Navies, Governments and Governmental Agencies;
- Overseas Shipbuilders, Ship Repairers and Defence Industries;

4.2 All elections are subject to confirmation by the Board.

4.3 All members of the Naval Ship Technical Committee are to hold security clearance from their National Authority for the equivalent of NATO CONFIDENTIAL. All material is to be handled in accordance with NATO Regulations or, for non-NATO countries, an approved equivalent. No classified material shall be disclosed to any third party without the consent of the originator.

4.4 The term of office of the Naval Ship Technical Committee Chairman and of all members of the Naval Ship Technical Committee is five years. Members may be re-elected to serve an additional term of office with the approval of the Board. The term of the Chairman may be extended with the approval of the Board.

4.5 In the case of continuous non-attendance of a member, the Naval Ship Technical Committee may withdraw membership.

4.6 The function of the Naval Ship Technical Committee is to consider technical issues connected with Naval Ship matters and to approve proposals for new Naval Ship Rules, or amendments to existing Naval Ship Rules. Where appropriate, Naval Ship Technical Committee may also recognise alternative LR Rule requirements that have been approved by the other Lloyd's Register Technical Committee as adjunct to the Naval Ship Rules.

4.7 Meetings of the Naval Ship Technical Committee are convened as necessary but there will be at least one meeting per year. Urgent matters may be considered by the Naval Ship Technical Committee by correspondence.

4.8 Any proposal involving any alteration in, or addition to, the General Regulations of Rules for Classification of Naval Ships is subject to approval of the Board. All other proposals for additions to or alterations to the Rules for Classification of Naval Ships, other than the General Regulations, will following consideration and approval by the Naval Ship Technical Committee, either at a meeting of the Naval Ship Technical Committee or by correspondence, be recommended to the Board for adoption.

4.9 The Naval Ship Technical Committee is empowered to:

(a) appoint sub-Committees or panels; and

(b) co-opt to the Naval Ship Technical Committee, or to its sub-Committees or panels, representatives of any organisation or industry or private individuals for the purpose of considering any particular problem.

Section 5
Applicability of Classification Rules and Disclosure of Information

5.1 LR has the power to adopt, and publish as deemed necessary, Rules relating to classification and has (in relation thereto) provided the following:

(a) Except in the case of a special directive by the Board, no new Regulation or alteration to any existing Regulation relating to classification or to class notations is to be applied to existing ships.

(b) Except in the case of a special directive by the Board, or where changes necessitated by mandatory implementation of International Conventions, Codes or Unified Requirements adopted by the International Association of Classification Societies are concerned, no new Rule or alteration in any existing Rule is to be applied compulsorily after the date on which the contract between the ship builder and shipowner for construction of the ship has been signed, nor within six months of its adoption. The date of 'contract for construction' of a ship is the date on which the contract to build the ship is signed between the prospective shipowner and the ship builder. This date and the construction number (i.e. hull numbers) of all the vessels included in the contract are to be declared by the party applying for the assignment of class to a newbuilding. The date of 'contract for construction' of a series of sister ships, including specified optional ships for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective shipowner and the ship builder. In this section a 'series of sister ships' is a series of ships built to the same approved plans for classification purposes, under a single contract for construction. The optional ships will be considered part of the same series of sister ships if the option is exercised not later than 1 year after the contract to build the series was signed. If a contract for construction is later amended to include additional ships or additional options, the date of 'contract for construction' for such ships is the date on which the amendment to the contract is signed between the prospective shipowner and the ship builder. The amendment to the contract is to be considered as a 'new contract'. If a contract for construction is amended to change the ship type, the date of 'contract for construction' of this modified vessel, or vessels, is the date on which the revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder. Where it is desired to use existing approved ship or machinery plans for a new contract, written application is to be made to LR. Sister ships may have minor design alterations provided that such alterations do not affect matters related to classification, or if the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the ship builder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to LR for approval.

(c) All reports of survey are to be made by surveyors authorised by members of the LR Group to survey and report (hereinafter referred to as 'the Surveyors') according to the form prescribed, and submitted for the consideration of the Classification Committee.

(d) Information contained in the reports of classification and statutory surveys will be made available to the relevant owner, National Administration, Port State Administration, P&I Club, hull underwriter and, if authorised in writing by that owner, to any other person or organisation.

(e) Notwithstanding the general duty of confidentiality owed by LR to its client in accordance with the LR Rules, LR clients hereby accept that, LR will participate in the IACS Early Warning System which requires each IACS member to provide its fellow IACS members and Associates with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the ship which may be the specific property of another party), to enable such useful information to be shared and utilised to facilitate the proper working of the IACS Early Warning System. LR will provide its client with written details of such information upon sending the same to IACS Members and Associates.

(f) Information relating to the status of classification and statutory surveys and suspensions/withdrawals of class together with any associated conditions of class will be made available as required by applicable legislation or court order.

(g) A Classification Executive consisting of senior members of LR's Classification Department staff shall carry out whatever duties that may be within the function of the Classification Committee that the Classification Committee assigns to it.

Section 6
Ethics

6.1 No LR Group employee is permitted under any circumstances, to accept, directly or indirectly, from any person, firm or company, with whom the work of the employee brings the employee into contact, any present, bonus, entertainment or honorarium of any sort whatsoever which is of more than nominal value or which might be construed to exceed customary courtesy extended in accordance with accepted ethical business standards.

Section 7
Non-Payment of Fees

7.1 LR has the power to withhold or, if already granted, to suspend or withdraw any ship from class (or to withhold any certificate or report in any other case), in the event of non-payment of any fee to any member of the LR Group.

Section 8
Limits of Liability

8.1 When providing services LR does not assess compliance with any standard other than the applicable LR Rules, international conventions and other standards agreed in writing.

8.2 In providing services, information or advice, LR does not warrant the accuracy of any information or advice supplied. Except as set out herein, LR will not be liable for any loss, damage or expense sustained by any person and caused by any act, omission, error, negligence or strict liability of LR or caused by any inaccuracy in any information or advice given in any way by or on behalf of LR even if held to amount to a breach of warranty. Nevertheless, if the Client uses LR services or relies on any information or advice given by or on behalf of LR and as a result suffers loss, damage or expense that is proved to have been caused by any negligent act, omission or error of LR or any negligent inaccuracy in information or advice given by or on behalf of LR then LR will pay compensation to the client for its proved loss up to but not exceeding the amount of the fee (if any) charged for that particular service, information or advice.

8.3 LR will print on all certificates and reports the following notice: Lloyd's Register Group Limited, its affiliates and subsidiaries and their respective officers, employees or agents are, individually and collectively, referred to in this clause as 'Lloyd's Register'. Lloyd's Register assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Lloyd's Register entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.

8.4 Except in the circumstances of section *Pt 1, Ch 1, 8 Limits of Liability 8.2* above, LR will not be liable for any loss of profit, loss of contract, loss of use or any indirect or consequential loss, damage or expense sustained by any person caused by any act, omission or error or caused by any inaccuracy in any information or advice given in any way by or on behalf of LR even if held to amount to a breach of warranty.

8.5 Any dispute about LR services is subject to the exclusive jurisdiction of the English courts and will be governed by English law.

Contents

Section

LR II.1
General

LR II.1.1 These Rules have been prepared to ensure that Bulk Chemical Tankers built with a view to classification with Lloyd's Register (LR), will also comply with the requirements of the IBC Code [1], as interpreted by LR, except as provided for in *LR II.2 Ship survival capability, fire protection and fire-extinction and operational requirements* of this introduction.

LR II.1.2 Responsibility for interpretation of IBC Code requirements for the purpose of issuing an International Certificate of Fitness for Chemical Tankers[1] lies with the Government of the State whose flag the ship is entitled to fly.[1] In this respect, attention is drawn to the IMO document *MSC/Circular.406/Rev.1 – Guidelines on Interpretation of the IBC Code and the IGC Code and Guidelines for the Uniform Application of the Survival Requirements of the IBC and IGC Codes – (Adopted on 29 June 1990)* dated 29th June, 1990 'Guidelines on Interpretations of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (*2014 IGC Code - International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*) and Guidelines for the Uniform Application of the Survival Requirements of the IBC and IGC Codes'. LR will apply these Interpretations for Classification purposes, where applicable. Attention is also drawn to the fact that LR is authorised to issue International Certificates of Fitness on behalf of several National Authorities.

LR II.1.3 The Rules incorporate the amendments of the IBC Code in full at the date of publication. For purposes of classification with Lloyd's Register of Shipping and assignment of the notations provided for in *Chapter LR III*, chemical tankers are required to comply with these Rules and the relevant provisions of LR's *Rules and Regulations for the Classification of Ships* (hereinafter referred to as Rules for Ships).[1] The words 'subject to the Code' where they appear in the text of the Code mean 'subject to these Rules in the context of these Rules'. Classification requirements which are additional to the requirements of the IBC Code have, as far as practicable, been included in these Rules, as sections or paragraphs inserted in appropriate positions in the Code text and are prefixed by 'LR'.

LR II.1.4 When authorised to issue an International Certificate of Fitness, LR will also be required to verify that the Ship Survival Capability and Location of Cargo Tanks requirements contained in *Chapter 2* and fire protection and fire-extinction requirements contained in *Chapter 11* have been complied with, in addition to classification requirements. On request, such investigations can also be carried out for, or on behalf of, a National Authority which has not authorised LR to issue an International Certificate of Fitness. When requested, LR will also issue an International Statement of Compliance with respect to all or part of the IBC Code, for the purpose of confirming to National Authorities that the ship complies fully with the applicable requirements, as interpreted by LR.

LR II.1.5 Ships built prior to the coming-into-force date of these Rules where the provisions of these Rules have not been applied will continue to be dealt with for classification purposes on the basis of LR's former *Rules for Chemical Tankers* except for fire protection, detection and extinction. In considering new or additional chemical cargoes for inclusion in the cargo lists of these ships, individual consideration, taking account of the ships' arrangements and the nature of the proposed cargoes, will require to be given. LR will carry out surveys for compliance with the *Bulk Chemical Code* [1] and issue International Certificates of Fitness or Statements of Compliance in a manner similar to that described in *LR II.1 General*.

[1] *See* definition in *Ch 1, 1.3 Definitions*.

LR II.2
Ship survival capability, fire protection and fire-extinction and operational requirements

LR II.2.1 The IBC Code contains requirements in respect of ship survival capability (damage stability), fire protection and fire-extinction and operational matters which are not within the scope of classification as defined in the Rules for Ships, but are the responsibility of the National Authority or Administration, *see also LR II.3 Executive responsibility*, responsible for issuing the International Certificate of Fitness.

LR II.2.2 Accordingly, LR does not require that ship survival capability, fire protection and fire-extinction be investigated for purposes of classification. An asterisk is employed in the ship type notation to indicate that this has not been considered.

LR II.2.3 Similarly, operational requirements which appear in the IBC Code will not be dealt with by LR for classification purposes.

LR II.3
Executive responsibility

LR II.3.1 For the purpose of classification, the definition of Administration, *Ch 1, 1.3 Definitions 1.3.2*, is to be taken as meaning LR, except insofar as ship survival capability and operational matters are concerned in instances where LR is not responsible for issuing the Certificate of Fitness.

LR II.3.2 For purposes of classification the words 'should be' in the IBC Code text are to be read as 'is to be' or 'are to be', as appropriate.

LR II.3.3 Where, for the purpose of issuing a Certificate of Fitness, a National Authority has specifically accepted an equivalent under the terms of *Ch 1, 1.4 Equivalents*, or has adopted an interpretation different from that quoted by LR in these Rules, individual consideration will be given to acceptance of the equivalent or interpretation concerned for the purposes of classification.

LR II.4
Chemicals to which the Code does not apply

LR II.4.1 *Chapter 18* contains a list of chemicals to which the IBC Code does not apply. For classification purposes the carriage of these listed products is therefore not restricted to Chemical Tankers constructed in accordance with these Rules and having class notations as listed in *LR III.1 General* and *LR III.2 Class Notation (refrigerated installation)*.

LR II.5
Units

LR II.5.1 SI units, with the equivalent metric units in brackets where applicable, have been used throughout these Rules.

Contents

■ *LR III.1* General

LR III.1.1 The regulations for classification and the assignment of class notations are given in *Pt 1, Ch 2, 2.3 Class notations (hull)* of the Rules for Ships.

LR III.1.2 Seagoing ships complying with the requirements of these Rules will be eligible to be classed **'100A1 Chemical Tanker ESP'** in association with a Ship Type notation.

LR III.1.3 Seagoing ships complying with the requirements of these Rules and the double hull requirements of *Pt 4, Ch 9 Double Hull Oil Tankers* of the Rules for Ships, which carry MARPOL 73/78 *Annex I of MARPOL 73/78Regulations for the Prevention of Pollution by Oil* cargoes as well as chemical cargoes will be eligible to be classed **'100A1 Double Hull Oil and Chemical Tanker ESP'** in association with a Ship Type notation.

LR III.1.4 Sea-going ships complying with the IBC Code as a Type 2 ship and where the ship is registered with a Flag Administration which supports the issuance and maintenance of dual certification for both Ship Type 2 and Ship Type 3 Certificates of Fitness, and where the Flag Administration has agreed to the issuance of dual Certificates of Fitness, will be eligible to be classed **100A1 Chemical Tanker, Ship Type 2 and Ship Type 3, ESP, or 100A1 Double Hull Oil and Chemical Tanker, Ship Type 2 and Ship Type 3, ESP**, as appropriate.

(a) **LR III.1.4.1** Where the ship is later registered with a Flag Administration which does not support the issuance of dual ship Type 2 and Ship Type 3 Certificates of Fitness, the class notation is to be amended accordingly.

LR III.1.5 The notation **ESP** serves to identify the ship as being subject to an Enhanced Survey Programme as detailed in *Pt 1, Ch 3, 3 Intermediate Surveys - Hull and machinery requirements* and *Pt 1, Ch 3, 6 Special Survey - Bulk carriers - Hull requirements*, *see also Pt 1, Ch 2, 2.3 Class notations (hull) 2.3.12* of the Rules for Ships.

LR III.1.6 Where a Certificate of Fitness has been issued by LR, as provided for in *LR II.1 General*, the notations **Ship Types 1**, **2**, or **3** will be assigned as appropriate. Where the Certificate of Fitness is issued by the appropriate National Authority, the notations **Ship Type 1***, **2*** or **3*** will be assigned. As the provisions outlined in *LR II.2 Ship survival capability, fire protection and fire-extinction and operational requirements* of these Rules are not required for classification, an asterisk is employed to indicate that the IBC Code requirements in these respects have not been verified by LR for the purposes of classification.

LR III.1.7 The assignment of a Ship Type notation will not imply that the ship is suitable for all cargoes listed in *Chapter 17* as requiring that Ship Type. Please refer to the list of Products in the International Certificate of Fitness. *See Chapter 6.*

■ *LR III.2* Class Notation (refrigerated installation)

LR III.2.1 The following class notations may be assigned as considered appropriate by the Committee, on application from Owners:

✠ Lloyd's RMC (BC)

This notation will be assigned to a classed chemical tanker, in which refrigeration equipment has been constructed, installed and tested in accordance with the relevant requirements of the Rules.

Lloyd's RMC (BC)

This notation will be assigned to a classed chemical tanker, where the equipment has been found equivalent to Rule requirements and tested in accordance with the relevant requirements of the Rules.

TC

This notation will be assigned to a classical chemical tanker, where temperature control systems have been found equivalent to Rule requirements and tested in accordance with the relevant requirement of the Rules.

LR III.3
Additional notations

LR III.3.1 Additional notations may be given for the following features:

LR III.3.1.1 Independent tanks, where fitted.

LR III.3.1.2 Maximum permissible relative density (specific gravity) for which the scantlings have been approved, where greater than 1,025, e.g. 'SG 2,0'.

LR III.3.1.3 Maximum permissible positive pressure/vacuum relief valve setting for which the scantlings have been approved, where greater than 0,21 bar gauge, e.g. 'pv+0,4 bar gauge'.

LR III.3.1.4 Tanks constructed of corrosion resistant materials, e.g. stainless steel ('CR(s.stl)'), or lined with corrosion resistant linings, e.g. rubber lining ('CR(r.l)').

LR III.3.2 Maximum temperature for which the scantlings have been approved, e.g. Maximum Temperature 80°C.

LR III.3.3 Where these features are confined to certain tanks, the tanks concerned will be identified in the notation, e.g. 'CR(s.stl), SG 1,85, 5 and 9 centre tanks; TC Nos. 10 and 11 centre tanks'.

LR III.3.4 Other notations, as appropriate to the arrangements, scantlings and service, may be assigned.

LR III.4
Cargoes to be carried

LR III.4.1 Except where the Rule requirements have been limited as provided for in *Ch 1, 1.1 Application 1.1.9*, there will be no objection to the carriage of oil cargoes in ships built in accordance with these Rules, provided the arrangements, scantlings and materials have been approved for this purpose and that compatibility with tank coatings is ensured, *see Ch 1, 6.1 Materials of construction and welding*.

LR III.4.2 Proposals for the carriage of additional cargoes on classed chemical tankers, the keels of which were laid before 1st July 1986 having the Type Notations 'Chemical tanker Type A', 'Chemical tanker Type B', 'Chemical tanker Type C' or the Cargo Notations 'Cargo Type A', 'Cargo Type B', or 'Cargo Type C' will be considered on the basis of the containment provisions of the IMO Code for the *Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk* (BCH Code). Cargoes which are required by the BCH Code to be carried on Type 1 or Type 2 ships will be considered as LR Type A cargoes for classification purposes. Cargoes which are permitted by the BCH Code to be carried on Type 3 ships will be considered as LR Type B cargoes for classification purposes, except that cargoes which additionally require containment separation from the ship's shell plating due, for example, to water reactivity or to the necessity for special materials of cargo tank construction, will be considered as LR Type A.

Contents

Section
LR IV.1

■ *LR IV.1*

In addition to the plans required by the relevant Chapters of the Rules for Ships, the following information and plans are to be submitted:

(a) Information:

(i) The 'LR Chemship Questionnaire' is to be submitted.

(ii) In addition, for cargo tanks manufactured from stainless steel plate or carbon steel plate clad with stainless steel, the surface finish specification, fabrication procedures and permitted repairs are to be submitted to LR at the earliest opportunity, see also *Ch 1, 6.1 Materials of construction and welding*.

(iii) Particulars and capacities of ventilation arrangements for spaces referred to in *Chapter 12* and any other spaces in which hazardous vapours may collect by virtue of the arrangement of openings.

(iv) Particulars of any special materials of construction.

(v) Particulars of any special containment features (e.g. pressure tanks).

(vi) The maximum contemplated cargo relative density and intended pressure/vacuum relief valve settings are to be indicated on the submitted midship section.

(vii) Details verifying compliance with the sizing of vent systems required by *Ch 1, 8.2 Cargo tank venting 8.2.4*

(viii) Particulars and arrangements of cargo tank gasfreeing systems.

(ix) Particulars of access, evacuation and rescue arrangements required by *Ch 1, 3.3 Cargo pump-rooms* and *Ch 1, 3.4 Access to spaces in the cargo area*.

(b) Plans:

Ship general arrangement giving location of:

(i) Hatches, tank cleaning and other openings within the cargo area.

(ii) Doors, hatches and other openings (e.g. vents) to cargo pump rooms, cargo service spaces, cofferdams, hold spaces containing independent tanks and void spaces.

(iii) Doors, hatches and other openings (e.g. vents and opening windows) to accommodation, pump rooms, control stations, machinery spaces and service spaces.

(iv) Independent tanks, lined or coated tanks, and tanks constructed of special materials.

Contents

■ *LR V.1* General

LR V.1.1 Application

LR V.1.1.1 The requirements of *Pt 4, Ch 9 Double Hull Oil Tankers** or *Pt 4, Ch 10 Single Hull Oil Tankers** of the Rules for Ships as applicable are to be applied to chemical tankers, except as required by the provisions of this Chapter. Particular attention is drawn to the minimum thickness requirements of *Pt 4, Ch 9, 10.2 Compartment minimum thickness**.

LR V.1.1.2 References marked * refer to the Rules for Ships.

LR V.1.2 General definitions and symbols

LR V.1.2.1 The following symbols, used in these Rules, are fully defined in *Pt 3, Ch 1, 6 Definitions**:

L = length of ship, in metres

B = moulded breadth of ship, in metres

D = moulded depth of ship, in metres

T = moulded draught of ship, in metres.

LR V.1.2.2 The following symbols are also used in this Chapter. Where these symbols are used in a different or more limited sense, with or without a distinguishing subscript, the amended definition is given at the head of the Section concerned.

h = the load height applied to the item under consideration, in metres

I = the moment of inertia, in cm^4, of a primary or secondary member in association with an effective width of attached plating, determined in accordance with *Pt 3, Ch 3, 3 Structural idealisation**

L_1 = length of ship, in metres, but need not be taken greater than 190 m

p_v = pressure/vacuum relief valve positive setting, not to be taken less than 0,2 bar gauge

S = span, in metres, of the primary or secondary member measured between effective span points. For the determination of span points, *see Pt 3, Ch 3, 3 Structural idealisation**

s = spacing of secondary members, in mm

t = thickness of plating, in mm

z = the section modulus, in cm^3 of the primary or secondary member, in association with an effective width of attached plating determined in accordance with *Pt 3, Ch 3, 3 Structural idealisation**

Z_B = actual hull section modulus at the keel, in cm^3, as determined in accordance with *Pt 3, Ch 3, 3 Structural idealisation**

Z_R = Rule hull section modulus, in cm^3, as determined from *Pt 3, Ch 4, 5 Hull bending strength**

ρ = relative density of cargo, but not to be taken less than 1,025

LR V.1.2.3 The expression 'primary member' as used in this Chapter is defined as a girder, transverse, vertical web, stringer, cross tie, buttress or double bottom floor. 'Secondary members' are supporting members other than primary members.

LR V.2 Materials

LR V.2.1 General

LR V.2.1.1 Materials are to comply with *Pt 3, Ch 2 Materials**.

LR V.2.1.2 Attention is also drawn to *Chapter 6* of these Rules.

LR V.2.1.3 The following symbols and definitions are applicable to these Rules:

k_L, k = higher tensile steel factor. For the determination of this factor, *see Pt 3, Ch 2, 1 Materials of construction* For mild steel k_L, k may be taken as 1,0.

See Ch 2, 2.2 Definition of yield stress for steel of the Rules for Materials for definition of yield stress for steel.

LR V.2.2 Austenitic and duplex stainless steel

LR V.2.2.1 The following symbols and definitions are applicable to these Rules:

$k_1 = \frac{235}{\sigma_{oRT}} \left(k_1 = \frac{24}{\sigma_{oRT}} \right)$

$k_2 = \frac{235}{\sigma_{oT}} \left(k_2 = \frac{24}{\sigma_{oT}} \right)$

σ_{oRT} = specified minimum yield or 0,2 per cent proof stress, in N/mm^2, at room temperature as specified in *Table 3.7.2 Mechanical properties for acceptance purposes* in Ch 3,7 of the Rules for Materials

σ_{oT} = specified minimum yield or 0,2 per cent proof stress, in N/mm^2, at the design temperature; this can be taken as

= $-40/_n(T) + 127 + \sigma_{oRT}$ for austenitic stainless steel without N grade designation

= $-48/_n(T) + 142 + \sigma_{oRT}$ for austenitic stainless steel with N grade designation

= $-65/_n(T) + 200 + \sigma_{oRT}$ for duplex stainless steel

T = design temperature in °C

LR V.2.2.2 Alternative to the specified minimum 0,2 per cent proof stress at room temperature stipulated in *Table 3.7.2 Mechanical properties for acceptance purposes* in Ch 3,7 of the Rules for Materials, the manufacturer's specification can be used. The mechanical properties at room temperature specified in the plate manufacturer's specification are to be regarded as the minimum values for acceptance purposes and are to be included on all construction plans. The properties at the design temperature are also to be shown on the plans.

LR V.2.2.3 The formulas given in *LR V.2.2 Austenitic and duplex stainless steel* for calculating σ_{oT} are valid for temperatures from 20°C to 200°C. For applications at higher temperatures, special consideration is required.

LR V.2.2.4 Where duplex steel grades are to be used in areas which are subject to fatigue loading the material factors as calculated above k_1 and k_2 are not to be less than 0,66.

LR V.2.3 Clad plates

LR V.2.3.1 For clad plates the specified minimum value of tensile strength or yield strength or 0,2 per cent proof stress can be calculated as:

$$\sigma_{CLAD} = \frac{t_1 \sigma_{01} + t_2 \sigma_{02}}{t_1 + t_2}$$

where

t_1 = thickness of base material, in mm

t_2 = thickness of cladding, in mm

σ_{01} = specified minimum yield or 0,2 per cent proof stress of base material, in N/mm^2

σ_{02} = specified minimum yield or 0,2 per cent proof stress of base cladding, in N/mm^2

■ *LR V.3* Longitudinal strength

LR V.3.1 General

LR V.3.1.1 The longitudinal strength standard is to comply with the relevant requirements of *Pt 3, Ch 4 Longitudinal Strength**.

LR V.3.2 Symbols

LR V.3.2.1 Symbols are defined in *LR V.1.2 General definitions and symbols*.

LR V.3.3 Loading conditions

LR V.3.3.1 The range of loading conditions examined for longitudinal strength is to be fully representative of the cargo and ballast loading patterns which will occur in service, taking account of the relative densities of intended cargoes and also cargo segregation requirements, which may result in partial filling or non-uniform loading. The range of conditions is not, however, to be less than as provided for in *Pt 4, Ch 9, 3.3 Loading conditions**.

LR V.3.3.2 In order to guard against high stresses being imposed through an unsatisfactory cargo or ballast loading, an approved instrument is to be provided for determining suitable loading, in all instances where a non-uniform load distribution may occur in service, as required by *Pt 3, Ch 4, 8.3 Loading instrument**.

LR V.3.3.3 Where an approved loading instrument is provided, the conditions in the Loading Manual will be verified using the instrument, and the Manual will be endorsed to the effect that any departures from these conditions in service are also to be arranged on the basis of the loading instrument.

LR V.3.3.4 Attention is drawn to the remaining requirements of *Pt 4, Ch 9, 3.3 Loading conditions**.

LR V.3.4 Hull section modulus

LR V.3.4.1 Where stainless steel, having a value of σ_1 or σ_2 less than 235 N/mm^2 (24 kgf/mm^2), is incorporated in continuous longitudinal material in the vicinity of deck or bottom, the hull section modulus is to be not less than $Z_R k_1$, or $Z_R k_2$ respectively.

LR V.3.4.2 Where continuous upperdeck longitudinals or girders are fitted externally, the Rule hull modulus is to be attained at a point equivalent to the depth of longitudinal or girder above the moulded deck line at side.

LR V.3.5 Hull buckling strength

LR V.3.5.1 The buckling requirements of *Pt 3, Ch 4, 7 Hull buckling strength** are to be satisfied where applicable. Where stainless steel is used the buckling requirements in *Pt 3, Ch 4, 7 Hull buckling strength** are to be evaluated with the standard deduction for corrosion, d_t = 0,5 mm. For clad plates the standard deduction for corrosion is to be taken as d_t = 0,5 mm for the plate side with stainless steel.

LR V.4
Hull envelope plating

LR V.4.1 General

LR V.4.1.1 The requirements for hull envelope plating as given for oil tankers in *Pt 4, Ch 9, 4 Hull envelope plating** are to be applied, except as provided for in this Section.

LR V.4.2 Side and bottom shell plating in way of cargo tanks

LR V.4.2.1 Additional calculations and reinforcement may be required for side and bottom plating forming part of the boundary structure of a cargo tank which is intended for:

(a) the carriage of cargoes having relative densities in excess of 1,025; or

(b) pressure/vacuum relief valve settings which exceed a positive value of 0,20 bar gauge or a negative value of 0,07 bar gauge.

LR V.4.3 Deck plating in way of cargo tanks

LR V.4.3.1 Deck plating which forms part of the boundary structure of a cargo tank is to comply with the requirements of *LR V.7 Cargo tank boundaries*, in addition to the relevant requirements of *Pt 4, Ch 9, 4 Hull envelope plating**.

LR V.4.3.2 Where a stainless steel cargo tank boundary forms part of the upper deck, the minimum deck thickness given in *Pt 4, Ch 9, 4 Hull envelope plating** may be reduced by the following amounts:

(a) Solid stainless steel: 5 per cent or 1 mm, whichever is the greater.

(b) Clad stainless steel: 5 per cent.

LR V.5
Hull framing

LR V.5.1 General

LR V.5.1.1 The framing requirements given for oil tankers in *Pt 4, Ch 9, 5 Hull framing** are to be applied, except as provided for in this Section.

LR V.5.2 Side and bottom longitudinals in cargo tanks

LR V.5.2.1 Additional calculations and strengthening may be required for side and bottom longitudinals forming part of the boundary structure of cargo tanks which are intended for:

(a) the carriage of cargoes having relative densities in excess of 1,025; or

(b) pressure/vacuum relief valve settings which exceed a positive value of 0,2 bar gauge or a negative value of 0,07 bar gauge.

LR V.5.3 Deck longitudinals in way of cargo tanks

LR V.5.3.1 Deck longitudinals forming part of the boundary structure of cargo tanks are to comply with the requirements of *LR V.7 Cargo tank boundaries*, in addition to the relevant requirements of *Pt 4, Ch 9, 5 Hull framing**.

LR V.5.3.2 Where upper deck longitudinals are fitted externally, arrangements are to be made to prevent tripping in way of transverse bulkheads. Continuity is to be maintained at the ends of the cargo tank region.

LR V.6
Double bottom construction

LR V.6.1 General

LR V.6.1.1 The requirements of this Section are to be considered additional to those of *LR V.7 Cargo tank boundaries* and *Pt 4, Ch 9, 3.3 Loading conditions**.

LR V.6.1.2 The depth of the double bottom is to be not less than as required by *Ch 1, 2.6 Location of cargo tanks* and is also to be not less than as required by *Pt 4, Ch 9, 3.3 Loading conditions**. For high relative density cargoes, *see also LR V.6.5 High relative density cargoes* of this Section.

LR V.6.1.3 Due regard is to be paid to the depth of double bottom necessary to accommodate suitably sized access openings, and maintain the required standard of strength.

LR V.6.1.4 Arrangements are to be provided to enable double bottom tanks situated below cargo tanks to be filled with water ballast to assist in gas-freeing these tanks.

LR V.6.1.5 Side girders are to be arranged in way of longitudinal bulkheads.

LR V.6.1.6 Transverse continuity of inner bottom structure is to be maintained in way of longitudinal bulkheads. Where a double bottom is fitted in centre tanks only, the inner bottom is to be suitably scarphed into the wing tank structure.

LR V.6.2 Symbols

LR V.6.2.1 The symbols used in this Section are defined as follows:

h = vertical distance from the mid-point of the span to the highest point of the tank, excluding the hatchway, in metres

S = span of longitudinals, in metres, measured between span points as shown in *Pt 3, Ch 3, 3 Structural idealisation**, but not to be taken less than 1,5 m.

LR V.6.2.2 Other symbols are defined in *LR V.1.2 General definitions and symbols*.

LR V.6.3 Inner bottom longitudinals

LR V.6.3.1 The section modulus of inner bottom longitudinals in ships fitted with double bottoms under the cargo tanks is to be not less than the greater of the following:

(a) *Pt 4, Ch 9, 6 Inner hull, inner bottom and longitudinal oiltight bulkheads**.

(b) $Z = 0{,}0081ksS^2(\rho(h + 0{,}9) + 10(p_V - 0{,}2))$ cm^3.

LR V.6.4 Struts

LR V.6.4.1 Where struts are fitted, their scantlings are to be not less than as required by *Pt 4, Ch 1, 8.5 Floors**. In addition, the axial stress in the strut and the shear stress in lapped end connections are not to exceed 108 N/mm^2 (11,0 kgf/mm^2) and 83,5 N/mm^2 (8,5 kgf/mm^2) respectively.

LR V.6.5 High relative density cargoes

LR V.6.5.1 Where cargoes of relative density in excess of 1,025 are to be carried, the height of the double bottom may be required to be increased and, in addition, the floor scantlings and associated arrangements are to comply with the requirements of this sub-Section.

LR V.6.5.2 The shear stress in double bottom floors, using net area in way of openings, is not to exceed 83,5 N/mm^2 (8,5 kgf/mm^2) in association with the greater of the two following loading standards:

(a) Empty cargo tank with draught to deck edge.

(b) Full cargo tank taking account of cargo relative density with draught = $\frac{T}{2}$ or $\left(T - \frac{L}{40}\right)$, whichever is the lesser.

LR V.6.5.3 Where floor stiffeners are lapped to bottom and inner bottom longitudinals, a shear stress of 83,5 N/mm^2 (8,5 kgf/mm^2) is not to be exceeded in the welded connection. Where the floor stiffeners are directly welded to bottom and inner bottom longitudinals, an axial stress of 108 N/mm^2 (11,0 kgf/mm^2) is not to be exceeded, except where approved deep penetration welding is used, in which case the axial stress is not to exceed 147 N/mm^2 (15,0 kgf/mm^2). For the purpose of this calculation, the following two loading standards are to be applied:

(a) Bottom longitudinal connections, draught to deck edge.

(b) Inner bottom longitudinal connections, full cargo tank, taking account of cargo relative density.

LR V.6.5.4 Where collars or lugs are fitted the proportion of loading taken by the floor stiffener will be considered on the basis of the design of the connection and the requirements of *Pt 3, Ch 10, 5.2 Arrangements at intersections of continuous secondary and primary members**.

LR V.6.5.5 Openings are not to be cut in double bottom floor panels adjacent to longitudinal bulkheads. Within a distance of 25 per cent of the floor span measured from supports, the edges of floor openings are to be re-inforced. Where the ratio of floor depth to floor thickness exceeds 100, the buckling strength of floor panels is to be verified by direct calculation.

LR V.6.5.6 Double bottom construction involving the use of struts is not, in general, to be adopted where the cargo relative density exceeds 1,5. Where struts are proposed for cargoes having relative densities greater than 1,025, consideration will be required to be given to the strut and longitudinal scantlings, and the strut end connections may be required to be bracketed.

LR V.7
Cargo tank boundaries

LR V.7.1 General

LR V.7.1.1 The requirements of this Section are related to the application of mild steel, solid stainless steel or stainless clad steel. Thicknesses derived for clad steel include the cladding. The thickness of the cladding itself is to be at least 1,5 mm at the tank sides and top, and 2,0 mm at the tank bottom.

LR V.7.1.2 In no case may tanks integral with the hull structure be used for a pressure/vacuum relief valve setting exceeding 0,7 bar gauge. The negative setting is assumed not to exceed 0,07 bar gauge.

LR V.7.1.3 Scantlings are to be suitable for the relative densities of the cargoes intended to be carried.

LR V.7.1.4 Where it is proposed to carry cargoes requiring temperature control for reasons of safe carriage, the temperature control arrangements are to be appropriate to the intended service and the characteristics of the cargo. Details are to be submitted.

LR V.7.1.5 Tank boundary scantlings are to be not less than the minimum standard required for oil tankers, i.e. as required by *Pt 4, Ch 9 Double Hull Oil Tankers**, without correction for relative density.

LR V.7.1.6 The ends of corrugated bulkheads are to be suitably supported, where necessary by fitting additional stiffening.

LR V.7.2 Symbols

LR V.7.2.1 The symbols used in this Section are defined as follows:

$$f = 1.1 - \frac{s}{2500l} \text{ but need not exceed 1,0}$$

h_1, h_2, h_3 are vertical distances, in metres, from a point one-third of the height of the plate above its lowest edge to:
for h_1 the highest point of the tank, excluding the hatchway
for h_2 the top of the overflow
for h_3 the level of test head defined in *Pt 3, Ch 1, 8 Inspection and workmanship**
h_4, h_5, h_6 are vertical distances, in metres, from the mid-point of the stiffener length, l_e, to:
for h_4 the highest point of the tank, excluding the hatchway
for h_5 the top of the overflow
for h_6 the level of test head defined in *Pt 3, Ch 1, 8 Inspection and workmanship**

K_c = plate thickness factor, in mm, *see LR V.7.4 Plating*

l = overall length of stiffener between the support points, in metres

l_e = effective length of stiffener, in metres, as defined in *Table 1.9.1 Watertight and deep tank bulkhead scantlings* of Pt 4, Ch 1*

p = pitch of symmetrical corrugations, in mm

s = stiffener spacing for plane and double plate bulkheads, in mm

= breadth of flange or web, whichever is the greater, for corrugated bulkheads, in mm

α_p = α_1, α_2, α_3, whichever is the greatest, where

$$\alpha_1 = \frac{\rho h_1}{1,025} + 10\left(p_{v-0,2}\right)$$

$$\alpha_2 = \frac{\rho h_2}{2,05}$$

$$\alpha_3 = \frac{h_3}{1,95}$$

α_s = α_4, α_5, α_6, whichever is the greatest, where

$$\alpha_4 = \frac{\rho h_4}{1,025} + 10\left(p_{v-0,2}\right)$$

$$\alpha_5 = \frac{\rho h_5}{2,05}$$

$$\alpha_6 = \frac{h_6}{1,95}$$

γ = 1,4 for rolled or built sections and double plate bulkheads

= 1,6 for flat bars

= 1,1 for symmetrical corrugations

ω_1, ω_2 = end constraint factors, values given in *Table 1.9.3 Bulkhead end constraint factors* of Pt 4, Ch 1*.

LR V.7.2.2 Other symbols are defined in *LR V.1.2 General definitions and symbols*.

LR V.7.3 Minimum thickness for stainless steel

LR V.7.3.1 Where stainless steel is used, the minimum thickness in cargo tanks required by *Pt 4, Ch 9, 10.2 Compartment minimum thickness** may be reduced by (2,5-K_c) mm, or is to be increased if K_c is greater than 2,5 mm. The final overall thickness of material is to be not less than 6,5 mm for tops and sides, and 7 mm for the bottoms, of tanks. *See also LR V.7.1 General* for minimum thickness of cladding.

LR V.7.4 Plating

LR V.7.4.1 The thickness of plating forming boundaries of cargo tanks is to be not less than given below, but may be required to be increased locally on account of high shear forces, in accordance with *Pt 3, Ch 4, 6 Hull shear strength**:

$$t = 0,004sf\sqrt{k\,\alpha_p} + K_c \text{ mm}$$

LR V.7.4.2 For mild steel construction, the value of the plate thickness factor, K_c, is 2,5 mm. For stainless steel, K_c depends upon the type of material and its position, as represented by the designation of the adjacent space. *See Table 1 Values of plate thickness factor, K_c for solid and clad stainless steel* .

Table 1 Values of plate thickness factor, K_c for solid and clad stainless steel

Item	Designation of space adjacent to cargo tank having stainless steel boundaries	K_c, in mm	
		Solid	Clad
1	Cargo tank	2	2,25
2	Dry space	1	1,5
3	Weather deck	1	1,5
4	Water ballast deep tank	*See Ch 1, 6.1 Materials of construction and welding*	2

5	Water ballast deep tank (coated)	1	1,5
6	Double bottom ballast tank	*See Ch 1, 6.1 Materials of construction and welding*	2,5
7	Double bottom ballast tank (coated)	1,5	2
8	Double bottom dry tank	1,5	2
9	Integral heating duct	2	3

LR V.7.5 Stiffeners and corrugations

LR V.7.5.1 The section modulus of rolled or fabricated stiffeners and double plate bulkhead supports is to be not less than:

$$Z = \frac{ks\,\alpha_s l_e^2}{22\,\gamma\left(w_1 + w_2 + 2\right)}\ \text{cm}^3$$

LR V.7.5.2 The inertia of rolled or fabricated stiffeners is to be not less than:

$$I = \frac{2,3}{k}\,l_e Z\ \text{cm}^4$$

LR V.7.5.3 For symmetrical corrugations, the section modulus is to be not less than:

$$Z = \frac{kp\,\alpha_s l_e^2}{22\,\gamma\left(w_1 + w_2 + 2\right)}\ \text{cm}^3$$

LR V.7.5.4 The remaining requirements of *Pt 4, Ch 9, 6 Inner hull, inner bottom and longitudinal oiltight bulkheads** or *Pt 4, Ch 9, 7 Transverse oiltight bulkheads** as applicable in respect of the proportions of stiffening members and corrugations are also to be fulfilled.

LR V.7.5.5 Where stainless steel is employed, the plating thickness calculated for corrugated bulkheads in accordance with *LR V. 7.5 Stiffeners and corrugations* may be reduced by (2,5-K_c) mm.

LR V.7.5.6 The section modulus of mild steel stiffeners attached to solid or clad stainless steel plating is to be based on the actual plating thickness.

LR V.7.5.7 Where solid stainless steel stiffeners are to be fitted, the thickness may be as required for mild steel, reduced by 0,5 mm.

LR V.7.5.8 Where σ_1 or σ_2 is less than 235 N/mm^2 (24 kgf/mm^2), scantlings are to be increased by substituting the corresponding value of k_1 or k_2 for k in tank boundary formulae for stiffener modulus and plating thickness. The value of k_1 or k_2 is not, however, to be used to reduce Rule inertia or plate thickness requirements as given, for example, in *LR V.7.5 Stiffeners and corrugations* and item 1(b) in *Table 9.7.1 Transverse oiltight bulkhead scantlings* of Pt 4, Ch 9* respectively.

LR V.7.6 Welding

LR V.7.6.1 Weld factors as given in Pt 3, Ch 10*, *Table 10.2.1 Weld factors* item (7) for Chemical Tankers are to be applied in conjunction with item (6) for Tankers of this Table.

■ *LR V.8* Primary structure

LR V.8.1 General

LR V.8.1.1 Direct calculation procedures are to be adopted where required by *Pt 4, Ch 9 Double Hull Oil Tankers**. Additional calculations may be required where these are justified by the intended design or loading conditions, for example:

(a) Where double-skin construction is contemplated in association with large openings in wing cofferdams.

(b) Where Rule primary member scantlings and arrangements designed for transverse strength purposes on the basis of *Pt 4, Ch 9 Double Hull Oil Tankers** are proposed for: the carriage of cargoes having relative densities in excess of 1,025, or pressure/vacuum relief valve settings which exceed a positive value of 0,2 bar gauge or a negative value of 0,07 bar gauge. *See also LR V.7.1 General*.

LR V.8.2 External deck transverses

LR V.8.2.1 Where deck transverses are fitted externally in way of the centre cargo tanks, the former are to be aligned with the internal deck transverses in wing tanks. The external transverses are to extend outboard of the longitudinal bulkheads to ensure continuity of structure and a satisfactory degree of end fixity. The outboard ends of the external transverses are to be tapered in the form of brackets, and slots in internal primary structure are to be collared in way.

LR V.8.2.2 Web stiffening and lateral support arrangements are to comply with *Pt 4, Ch 9, 10 Construction details and minimum thickness** and are to include tripping brackets in line with longitudinal bulkheads. Tripping brackets fitted in way of wing tanks are to be supported by suitable underdeck structure.

LR V.8.2.3 Where continuous upperdeck girders are fitted externally, structural continuity is to be maintained.

LR V.8.2.4 External deck transverses and girders are in general to comply with cargo tank minimum thickness requirements.

LR V.9
Direct calculations

LR V.9.1 General

LR V.9.1.1 Attention is drawn to LR's *ShipRight Structural Design Assessment procedure, Direct calculations - Guidance notes, Primary structure of tankers*.

LR V.9.2 Design loads

LR V.9.2.1 Where direct calculations are required, account is to be taken of cargo relative densities in excess of 1,025 (*see also LR V.6.5 High relative density cargoes* and *LR V.6.5 High relative density cargoes*), associated test heads (*see Pt 3, Ch 1 General**) and pressure/vacuum relief valve settings which exceed positive or negative values of 0,2 bar gauge and 0,07 bar gauge respectively. *See also LR V.7.1 General*.

LR V.10
Heated cargoes

LR V.10.1 General

LR V.10.1.1 In order to facilitate assessment of the seagoing operating temperatures of cargo tank structure, a temperature distribution investigation is to be submitted when:

(a) the cargo heating source is integral with the structure of cargo tank boundaries which are not in contact with the sea, or

(b) heated cargoes are to be carried in longitudinally framed ships at temperatures exceeding 80°C in integral tanks. Consideration will be given to permissible temperatures for ships with partial transverse framing, taking account of the submitted structural arrangements.

LR V.10.1.2 If the steel temperature exceeds the values given above, calculations giving resultant stresses on the hull structure, based on a sea temperature of 0°C and an air temperature of 5°C, are to be submitted, together with proposals for necessary reinforcement of the hull structure and/or limitation of the still water bending moment for heated cargo conditions.

LR V.10.1.3 Submitted proposals are to take account of non-uniform loading patterns with resultant variations in temperature distribution, where appropriate.

LR V.10.1.4 Provided that the heat source is not adjacent to the hull structure, cargo temperatures of up to 80°C will be accepted without temperature and thermal stress calculations, in cases where transverse framing is adopted for longitudinal bulkhead and side shell, and the integral cargo tanks have common boundaries with the sea.

LR V.10.1.5 For bituminous cargoes which form a mastic layer on cargo tank boundaries, acceptance of higher temperatures in integral centre tanks of single bottom tankers without thermal stress investigation will be considered provided the appropriate requirements of MARPOL 73/78 *Annex I of MARPOL 73/78Regulations for the Prevention of Pollution by Oil* are complied with.

LR V.10.1.6 Where molten cargoes are to be carried at temperatures which may result in excessive condensation in spaces adjacent to cargo tanks, consideration will be given, in appraisal, to the possibility of increased corrosion and the need for additional protection.

LR V.10.2 Application of stainless steel

LR V.10.2.1 Where integral stainless steel tanks are to be used for heated cargoes, and the conditions specified in *LR V.10.1 General* (a) or (b) apply, account is to be taken of the operating steel temperature. Where σ_2 is less than 235 N/mm^2 (24 kgf/mm^2), scantlings are to be increased by substituting the corresponding value of k_2 for k in the cargo tank boundary formulae for stiffener and plating thickness. The value of k_2 is not, however, to be used to reduce Rule inertia or plate thickness requirements. Also, the hull section modulus is to be not less than $Z_R k_2$ where stainless steel is incorporated in continuous longitudinal material in the vicinity of deck or bottom.

LR V.10.2.2 Where clad steel is fitted, k_2 is to be calculated on the basis of the yield stress or 0,2 per cent proof stress of the stainless steel cladding at the operating temperature.

LR V.10.3 Heating ducts

LR V.10.3.1 Where heating ducts are integral with the tank structure, they are to be designed to withstand a head equal to the maximum pressure in the heating system, but in no case less than that imposed by the highest cargo load for which the tanks have been designed.

LR V.10.3.2 For other aspects of cargo heating, *see Pt 5, Ch 15, 6 Cargo heating arrangements**.

Contents

Section

■ *LR VI.1*
Inert Gas Systems on Chemical Tankers of 8,000 tonnes DWT and above

LR VI.1.1 An inert gas system complying with the applicable requirements of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* , is to be fitted on tankers of 8,000 tonnes DWT and above. In applying the applicable requirements of *Chapter 15 - Inert Gas Systems* of the FSS Code, any use of the word "Administration" therein is to be considered as meaning LR.

■ *LR VI.2*
Nitrogen Generator Systems on Chemical Tankers of 8,000 tonnes DWT and above

LR VI.2.1 The following requirements apply where a nitrogen generator system is fitted on board tankers of 8,000 tonnes DWT and above. For the purpose, the inert gas is to be produced by separating air into its component gases by passing compressed air through a bundle of hollow fibres, semi-permeable membranes or adsorber materials.

LR VI.2.2 In addition to the applicable requirements of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* , the nitrogen generator system is to comply with SOLAS Regulations II-2/4 *5.3 Cargo tank venting*, *5.6 Inerting, purging and gas-freeing* and *6 Protection of cargo tank structure against pressure or vaccuum in tankers*.

LR VI.2.3 A nitrogen generator consisting of a feed air treatment system and any number of membrane or adsorber modules in parallel is to be capable of delivering nitrogen to the cargo tanks at the rate required by paragraph 2.2.1.2.4 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* .

LR VI.2.4 The nitrogen generator is to be capable of delivering high purity nitrogen with an oxygen content in accordance with paragraph 2.2.1.2.5 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* . In addition to meeting the venting requirements of paragraph 2.2.2.4 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* , the system is to be fitted with automatic means to discharge “off-spec” gas to the atmosphere during start-up and abnormal operation.

LR VI.2.5 The system is to be provided with one or more compressors to generate enough positive pressure to be capable of delivering the total volume of gas required by 2.2.1.2 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* . Where two compressors are provided, the total required capacity of the system is preferably to be divided equally between the two compressors, and in no case is one compressor to have a capacity less than 1/3 of the total capacity required.

LR VI.2.6 Where the nitrogen system includes a nitrogen storage tank which has sufficient capacity to deliver the total volume of gas required by 2.2.1.2 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* , in the event of failure of a compressor a single compressor may be accepted provided that sufficient spares are carried on board to enable the failure to be rectified by the ship’s crew. The list of spare parts required is to be supplied by the manufacturer and supported by a reliability analysis of the specific system submitted to and verified by LR. The size of the nitrogen storage tank is to be specified.

LR VI.2.7 The feed air treatment system fitted to remove free water, particles and traces of oil from the compressed air, as required by 2.4.1.2 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the*

International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014) , is also to maintain the specification temperature.

LR VI.2.8 The oxygen-enriched air from the nitrogen generator and the nitrogen-product enriched gas from the protective devices of the nitrogen receiver are to be arranged to discharge to a safe location on the open deck. This safe location needs to address the two types of discharges separately.

For oxygen-enriched air from the nitrogen generator, safe locations on the open deck are:

- outside of hazardous areas as defined by *Pt 6, Ch 2, 13.5 Discharge lighting* of the Rules for Ships;
- not within 3 m of areas traversed by personnel;
- not within 6 m of air intakes for machinery and all ventilation inlets.

For nitrogen-product enriched gas from the protective devices of the nitrogen receiver, safe locations on the open deck are:

- not within 3 m of areas traversed by personnel;
- not within 6 m of air intakes for machinery and all ventilation inlets/outlets.

LR VI.2.9 In order to permit maintenance, means of isolation are to be fitted between the generator and the receiver.

LR VI.3
Nitrogen/inert gas systems fitted for purposes other than inerting required by SOLAS Reg. II-2/4.5.5.2

LR VI.3.1 This section applies to systems fitted to which SOLAS regulation II-2/4.5.5.2 does not apply.

LR VI.3.2 The requirements given in *Chapter 15 - Inert Gas Systems*, 2.2.2, 2.2.4, 2.4.1 and 2.4.2 of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* , apply to the systems as applicable.

LR VI.3.3 The requirements of *LR VI.2 Nitrogen Generator Systems on Chemical Tankers of 8,000 tonnes DWT and above* apply except *LR VI.2 Nitrogen Generator Systems on Chemical Tankers of 8,000 tonnes DWT and above*, *LR VI.2 Nitrogen Generator Systems on Chemical Tankers of 8,000 tonnes DWT and above*, *LR VI.2 Nitrogen Generator Systems on Chemical Tankers of 8,000 tonnes DWT and above*, *LR VI.2 Nitrogen Generator Systems on Chemical Tankers of 8,000 tonnes DWT and above* and *LR VI.2 Nitrogen Generator Systems on Chemical Tankers of 8,000 tonnes DWT and above*.

LR VI.3.4 Materials used in inert gas systems are to be suitable for their intended purpose in accordance with the LR Rules for Materials.

LR VI.3.5 All the equipment is to be installed on board and tested under working conditions to the satisfaction of the Surveyor.

LR VI.3.6 The two non-return devices as required by paragraph 2.2.3.1.1 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* are to be fitted in the inert gas main. The non-return devices are to comply with 2.2.3.1.2 and 2.2.3.1.3 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* ; however, where the connections to the cargo tanks, to the hold spaces or to cargo piping are not permanent, the non-return devices required by paragraph 2.2.3.1.1 of *Chapter 15 - Inert Gas Systems* of the FSS Code, as amended by *Resolution MSC.367(93) – Amendments to the International Code for Fire Safety Systems (FSS Code) – (Adopted on 22 May 2014)* may be substituted by two non-return valves.

Contents

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

Section

Introduction

Preamble

The purpose of this Code is to provide an international standard for the safe carriage, in bulk by sea, of dangerous chemicals and noxious liquid substances listed in *chapter 17* of the Code. The Code prescribes the design and construction standards of ships, regardless of tonnage, involved in such carriage and the equipment they shall carry to minimize the risk to the ship, its crew and the environment, having regard to the nature of the products involved.

The basic philosophy of the Code is to assign, to each chemical tanker, one of the ship types according to the degree of the hazards of the products carried by such ships. Each of the products may have one or more hazardous properties, including flammability, toxicity, corrosivity and reactivity, as well as the hazard they may present to the environment.

Throughout the development of the Code it was recognized that it must be based upon sound naval architectural and engineering principles and the best understanding available as to the hazards of the various products covered. Furthermore, chemical tanker

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

design technology is not only a complex technology, but is rapidly evolving and therefore the Code should not remain static. Thus, the Organization will periodically review the Code, taking into account both experience and technical developments.

Amendments to the Code involving requirements for new products and their conditions of carriage will be circulated as recommendations, on an interim basis, when adopted by the Maritime Safety Committee (MSC) and the Marine Environment Protection Committee (MEPC) of the Organization, in accordance with the provisions of article VIII of the International Convention for the Safety of Life at Sea, 1974 (SOLAS 74), and *Article 16 - Amendments* of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), respectively, pending the entry into force of these amendments.

The Code primarily deals with ship design and equipment. In order to ensure the safe transport of the products, the total system must, however, be appraised. Other important facets of the safe transport of the products, such as training, operation, traffic control and handling in port, are being, or will be, examined further by the Organization.

The development of the Code has been greatly assisted by a number of organizations in consultative status such as the Association of Classification Societies (IACS) and the International Electrotechnical Commission (IEC).

Chapter 16 of the Code, dealing with operational requirements of chemical tankers, highlights the regulations in other chapters that are operational in nature and mentions those other important safety features that are peculiar to chemical tanker operation.

The layout of the Code is in line with the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (*2014 IGC Code - International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*), adopted by the Maritime Safety Committee at its forty-eighth session. Gas carriers may also carry in bulk liquid chemicals covered by this Code, as prescribed in the *2014 IGC Code - International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*.

The 1998 edition of the Code was based on the original text as adopted by MSC resolution MSC.4(48). In response to resolution 15 of the International Conference on Marine Pollution, 1973, the MEPC, at its twenty-second session, adopted, by resolution MEPC.19(22), the IBC Code extended to cover marine pollution prevention aspects for the implementation of *Annex II of MARPOL 73/78Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk* to MARPOL 73/78.

This edition of the Code includes amendments adopted by the following resolutions:

	Resolution	**Adoption**	**Deemed acceptance**	**Entry into force**
1	MSC.10(54)	29 April 1987	29 April 1988	30 October 1988
2	MSC.14(57)	11 April 1989	12 April 1990	13 October 1990
	MEPC.32(27)	17 March 1989	12 April 1990	13 October 1990
3	MSC.28(61)	11 December 1992	1 January 1994	1 July 1994
	MEPC.55(33)	30 October 1992	1 January 1994	1 July 1994
4	MSC.50(66)	4 June 1996	1 January 1998	1 July 1998
	MEPC.69(38)	10 July 1996	1 January 1998	1 July 1998
5	MSC.58(67)	5 December 1996	1 January 1998	1 July 1998
	MEPC.73(39)	10 March 1997	10 January 1998	10 July 1998
6	MSC.102(73)	5 December 2000	1 January 2002	1 July 2002
7	MSC.176(79)	9 December 2004	1 July 2006	1 January 2007
	MEPC.119(52)	15 October 2004	1 July 2006	1 January 2007
8	MSC.219(82)	8 December 2006	1 July 2008	1 January 2009
	MEPC.166(56)	13 July 2007	1 July 2008	1 January 2009

As from the date of entry into force of the 1983 amendments to *SOLAS - International Convention for the Safety of Life at Sea* (i.e. 1 July 1986) and the date of implementation of *Annex II of MARPOL 73/78Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk* of MARPOL 73/78 (i.e. 6 April 1987), this Code became subject to mandatory requirements under these Conventions. Amendments to the Code, whether from the point of view of safety or of marine pollution, must therefore be adopted

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

and brought into force in accordance with the procedures laid down in *Article VIII - Amendments* of SOLAS 74 and *Article 16 - Amendments* of MARPOL 73/78 respectively.

General

1.1 Application

1.1.1 The Code applies to ships regardless of size, including those of less than 500 gross tonnage, engaged in the carriage of bulk cargoes of dangerous chemicals or noxious liquid substances (NLS), other than petroleum or similar flammable products as follows:

(a) products having significant fire hazards in excess of those of petroleum products and similar flammable products;

(b) products having significant hazards in addition to or other than flammability.

1.1.2 Products that have been reviewed and determined not to present safety and pollution hazards to such an extent as to warrant the application of the Code are found in *chapter 18*.

1.1.3 Liquids covered by the Code are those having a vapour pressure not exceeding 0.28 MPa absolute at a temperature of 37.8°C.

1.1.4 For the purpose of the *SOLAS - International Convention for the Safety of Life at Sea*, the Code applies to ships which are engaged in the carriage of products included in *chapter 17* on the basis of their safety characteristics and identified as such by an entry of S or S/P in *column d*.

1.1.5 For the purposes of *MARPOL - International Convention for the Prevention of Pollution from Ships*, the Code applies only to NLS tankers, as defined in regulation 1.16.2 of Annex II thereof, which are engaged in the carriage of Noxious Liquid Substances identified as such by an entry of X, Y or Z in *column c* of*chapter 17* .

1.1.6 For a product proposed for carriage in bulk, but not listed in chapters *17* or *18*, the Administration and port Administrations involved in such carriage shall prescribe the preliminary suitable conditions for the carriage, having regard to the criteria for hazard evaluation of bulk chemicals. For the evaluation of the pollution hazard of such a product and assignment of its pollution category, the procedure specified in *Regulation 6 - Categorization and listing of Noxious Liquid Substances and other substances .3* of Annex II of MARPOL 73/78 must be followed. The Organization shall be notified of the conditions for consideration for inclusion of the product in the Code.

1.1.7 Unless expressly provided otherwise, the Code applies to ships, the keels of which are laid or which are at the stage where:

(a) construction identifiable with the ship begins; and

(b) assembly has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less;

on or after 1 July 1986.

LR 1.1(a) For classification purposes these Rules may, but need not be, applied to ships for which the midship section is approved prior to 1 July 1986.

1.1.8 A ship, irrespective of the date of construction, which is converted to a chemical tanker on or after 1 July 1986 shall be treated as a chemical tanker constructed on the date on which such conversion commences. This conversion provision does not apply to the modification of a ship referred to in *Regulation 1 - Definitions .15* of Annex II of MARPOL 73/78.

1.1.9 Where reference is made in the Code to a paragraph, all the provisions of the subparagraphs of that designation shall apply.

LR 1.1(b) For classification purposes these Rules apply to the arrangements and scantlings of sea-going tankers intended for the carriage of bulk liquid cargoes included in *Chapter 17* and also cover the carriage of cargoes listed in *Chapter 18*. The requirements of LR's Rules for Ships, including *Pt 4, Ch 9 Double Hull Oil Tankers*, are also to be complied with as appropriate to the contemplated class notation and cargoes.

LR 1.1(c) The requirements contained in these Rules apply to chemical tankers having single or double bottom, single or double skin, with or without deck cofferdam, also separate or independent tanks as appropriate to ship type and to cargo containment requirements.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

LR 1.1(d) Where a ship is designed to carry a limited number of specific cargoes, consideration will be given for classification purposes to application of Rule requirements as appropriate to the particular hazards involved.

LR 1.1(e) The classification content of these Rules does not cover the inter-compatibility aspects of chemical cargoes. The arrangements of tanks and associated systems are, however, to be such as will permit the handling and simultaneous carriage of different liquid cargoes except as provided for in *Ch 1, 1.1 Application 1.1.9*. Arrangements for conserving the quality of the cargo are the responsibility of the Owner.

LR 1.1(f) For ships intended for the carriage of liquefied petroleum or natural gases, *see* the *Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk, July 2017*.

1.2 Hazards

1.2.1 Hazards of products covered by the Code include:

1.2.2 *Fire hazard*, defined by flashpoint, explosive/flammability limits/range and autoignition temperature of the chemical.

1.2.3 *Health hazard*, defined by:

(a) corrosive effects on the skin in the liquid state; or
(b) acute toxic effect, taking into account values of:

LD_{50} (oral): a dose, which is lethal to 50% of the test subjects when administered orally;

LD_{50} (dermal): a dose, which is lethal to 50% of the test subjects when administered to the skin;

LC_{50} (inhalation): the concentration which is lethal by inhalation to 50% of the test subjects; or
(c) Other health effects such as carcinogenicity and sensitization.

1.2.4 *Reactivity hazard*, defined by reactivity:

(a) with water;
(b) with air;
(c) with other products; or
(d) of the product itself (e.g. polymerization).

1.2.5 *Marine pollution hazard*, as defined by:

(a) bioaccumulation;
(b) lack of ready biodegradibility;
(c) acute toxicity to aquatic organisms;
(d) chronic toxicity to aquatic organisms;
(e) long term human health effects; and
(f) physical properties resulting in the product floating or sinking and so adversely affecting marine life.

1.3 Definitions

The following definitions apply unless expressly provided otherwise. (Additional definitions are given in individual chapters).

1.3.1 *Accommodation spaces* are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, barber shops, pantries containing no cooking appliances and similar spaces. *Public spaces* are those portions of the accommodation spaces which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

1.3.2 *Administration* means the Government of the State whose flag the ship is entitled to fly. For *Administration (Port)* see *Port Administration*.

1.3.3 *Anniversary date* means the day and the month of each year, which will correspond to the date of expiry of the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

1.3.4 *Boiling point* is the temperature at which a product exhibits a vapour pressure equal to the atmospheric pressure.

1.3.5 *Breadth (B)* means the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material. The breadth (B) shall be measured in metres.

LR 1.3(a) *The Bulk Chemical Code is the Code* for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (Resolution MEPC 20(22)) and (Resolution MSC 9(53)).

1.3.6 *Cargo area* is that part of the ship that contains cargo tanks, slop tanks, cargo pump-rooms including pump-rooms, cofferdams, ballast or void spaces adjacent to cargo tanks or slop tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above-mentioned spaces. Where independent tanks are installed in hold spaces, cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forward-most hold space are excluded from the cargo area.

LR1.3(b) *Cargo control room or station* is a space used in the control of cargo handling operations.

1.3.7 *Cargo pump-room* is a space containing pumps and their accessories for the handling of the products covered by the Code.

1.3.8 *Cargo service spaces* are spaces within the cargo area used for workshops, lockers and store-rooms of more than 2 m^2 in area, used for cargo-handling equipment.

1.3.9 *Cargo tank* is the envelope designed to contain the cargo.

LR1.3(c) *Certificate of Fitness* is the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk issued under the provisions of the IBC Code, as amended.

1.3.10 *Chemical tanker* is a cargo ship constructed or adapted and used for the carriage in bulk of any liquid product listed in *chapter 17*.

1.3.11 *Cofferdam* is the isolating space between two adjacent steel bulkheads or decks. This space may be a void space or a ballast space.

1.3.12 *Control stations* are those spaces in which ship's radio or main navigating equipment or the emergency source of power is located or where the fire-recording or fire-control equipment is centralized. This does not include special fire-control equipment which can be most practically located in the cargo area.

1.3.13 *Dangerous chemicals* means any liquid chemicals designated as presenting a safety hazard, based on the safety criteria for assigning products to *chapter 17*.

1.3.14 *Density* is the ratio of the mass to the volume of a product, expressed in terms of kilograms per cubic metre. This applies to liquids, gases and vapours.

1.3.15 *Explosive/flammability limits/range* are the conditions defining the state of fuel-oxidant mixture at which application of an adequately strong external ignition source is only just capable of producing flammability in a given test apparatus.

1.3.16 *Flashpoint* is the temperature in degrees Celsius at which a product will give off enough flammable vapour to be ignited. Values given in the Code are those for a "closed-cup test" determined by an approved flashpoint apparatus.

1.3.17 *Hold space* is the space enclosed by the ship's structure in which an independent cargo tank is situated.

LR 1.3(d) *The IBC Code* is the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, as amended.

1.3.18 *Independent* means that a piping or venting system, for example, is in no way connected to another system and that there are no provisions available for the potential connection to other systems.

1.3.19 *Length (L)* means 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel, the waterline on which this length is measured shall be parallel to the designed waterline. The length (L) shall be measured in metres.

1.3.20 *Machinery spaces of category A* are those spaces and trunks to such spaces which contain:

(a) internal-combustion machinery used for main propulsion; or
(b) internal-combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or
(c) any oil-fired boiler or fuel oil unit or any oil fired equipment other than boilers, such as inert gas generators, incinerators etc.

1.3.21 *Machinery spaces* are all machinery spaces of category A and all other spaces containing propelling machinery, boilers, fuel oil units, steam and internal-combustion engines, generators and major electrical machinery, oil filling station, refrigerating, stabilizing, ventilation and airconditioning machinery, and similar spaces, and trunks to such spaces.

1.3.22 *MARPOL - International Convention for the Prevention of Pollution from Ships* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, as amended.

1.3.23 *Noxious Liquid Substance* means any substance indicated in the Pollution Category column of chapters *17* or *18* of the International Bulk Chemical Code, or the current MEPC.2/Circular or provisionally assessed under the provisions of *Regulation 6 - Categorization and listing of Noxious Liquid Substances and other substances .3* of MARPOL Annex II as falling into categories X, Y or Z.

LR 1.3(e) *National Authority* is the Government of the State whose Flag the ship is entitled to fly.

1.3.24 *Fuel oil unit* is the equipment used for the preparation of fuel oil for delivery to an oil-fired boiler, or equipment used for the preparation for delivery of heated oil to an internal-combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a gauge pressure of more than 0.18 MPa.

1.3.25 *Organization* is the International Maritime Organization (IMO).

1.3.26 *Permeability* of a space means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space.

1.3.27 *Port administration* means the appropriate authority of the country in the port of which the ship is loading or unloading.

1.3.28 *Products* is the collective term used to cover both Noxious Liquid Substances and Dangerous Chemicals.

1.3.29 *Pump-room* is a space, located in the cargo area, containing pumps and their accessories for the handling of ballast and fuel oil.

1.3.30 *Recognized standards* are applicable international or national standards acceptable to the Administration or standards laid down and maintained by an organization which complies with the standards adopted by the Organization and which is recognized by the Administration.

1.3.31 *Reference temperature* is the temperature at which the vapour pressure of the cargo corresponds to the set pressure of the pressure-relief valve.

LR 1.3(f) *Rules for Ships* are Lloyd's Register's *Rules and Regulations for the Classification of Ships, July 2017* and Rules for Materials are Lloyd's Register's *Rules for the Manufacture, Testing and Certification of Materials, July 2017* .

1.3.32 *Separate* means that a cargo piping system or cargo vent system, for example, is not connected to another cargo piping or cargo vent system.

1.3.33 *Service spaces* are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, store-rooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

1.3.34 *SOLAS - International Convention for the Safety of Life at Sea* means the International Convention for the Safety of Life at Sea, 1974, as amended.

LR 1.3(g) *Statement of Compliance* is a statement issued in respect of eligible ships to the effect that as far as LR is concerned, the vessel complies with the requirements of the IBC Code, or the Bulk Chemical Code.

1.3.35 *Vapour pressure* is the equilibrium pressure of the saturated vapour above a liquid expressed in Pascals (Pa) at a specified temperature.

1.3.36 *Void space* is an enclosed space in the cargo area external to a cargo tank, other than a hold space, ballast space, fuel oil tank, cargo pump-room, pump-room, or any space in normal use by personnel.

1.4 Equivalents

1.4.1 Where the Code requires that a particular fitting, material, appliance, apparatus, item of equipment or type thereof shall be fitted or carried in a ship, or that any particular provision shall be made, or any procedure or arrangement shall be complied with, the Administration may allow any other fitting, material, appliance, apparatus, item of equipment or type thereof to be fitted or carried, or any other provision, procedure or arrangement to be made in that ship, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus, item of equipment or type thereof or that any particular provision, procedure or arrangement is at least as effective as that required by the Code. However, the Administration may not allow operational methods or procedures to be made an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof, which are prescribed by the Code, unless such substitution is specifically allowed by the Code.

1.4.2 When the Administration allows any fitting, material, appliance, apparatus, item of equipment, or type thereof, or provision, procedure, or arrangement, or novel design or application to be substituted, it shall communicate to the Organization the particulars thereof, together with a report on the evidence submitted, so that the Organization may circulate the same to other

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

Contracting Governments to *SOLAS - International Convention for the Safety of Life at Sea* and Parties to *MARPOL - International Convention for the Prevention of Pollution from Ships*for the information of their officers.

1.5 Surveys and Certification

1.5.1 Survey procedure

1.5.1.1 The survey of ships, so far as regards the enforcement of the provisions of the regulations and granting of exemptions therefrom, shall be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it.

1.5.1.2 The recognized organization, referred to in *Regulation 8 - Surveys [Harmonised Requirements] .2* of MARPOL Annex II shall comply with the guidelines adopted by the Organization by *IMO Resolution A.739(18) – Guidelines for the Authorization of Organizations Acting on Behalf of the Administration – (Adopted on 4 November 1993)Amended by Resolution MSC.208(81)*, as may be amended by the Organization, and the specification adopted by the Organization by *IMO Resolution A.789(19) – Specifications on the Survey and Certification Functions of Recognized Organizations Acting on Behalf of the Administration – (Adopted on 23 November 1995)*, as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of *Article 16 - Amendments* of MARPOL and *Article VIII - Amendments* of SOLAS concerning the amendment procedures applicable to this Code.

1.5.1.3 The Administration nominating surveyors or recognizing organizations to conduct surveys shall, as a minimum, empower any nominated surveyor or recognized organization to:

(a) require repairs to a ship; and

(b) carry out surveys if requested by the appropriate authorities of a port State.

The Administration shall notify the Organization of the specific responsibilities and conditions of the authority delegated to nominated surveyors or recognized organizations for circulation to the Contracting Governments.

1.5.1.4 When a nominated surveyor or recognized organization determines that the condition of a ship or its equipment does not correspond substantially with the particulars of the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, or is such that the ship is not fit to proceed to sea without danger to the ship, or persons on board, or without presenting unreasonable threat of harm to the marine environment, such surveyor or organization shall immediately ensure that corrective action is taken and shall, in due course, notify the Administration. If such corrective action is not taken the Certificate shall be withdrawn and the Administration shall be notified immediately. If the ship is in a port of another Contracting Government, the appropriate authorities of the port State shall also be notified immediately. When an officer of the Administration, a nominated surveyor or a recognized organization has notified the appropriate authorities of the port State, the Government of the port State concerned shall give such officer, surveyor or organization any necessary assistance to carry out their obligations under this paragraph. When applicable, the Government of the port State concerned shall take such steps as will ensure that the ship does not sail until it can proceed to sea or leave the port for the purpose of proceeding to the nearest appropriate repair yard available without danger to the ship or persons on board or without presenting an unreasonable threat of harm to the marine environment.

1.5.1.5 In every case, the Administration shall guarantee the completeness and efficiency of the survey, and shall undertake to ensure the necessary arrangements to satisfy this obligation.

1.5.2 Survey requirements

LR 1.5.2(a) The Classification Regulations for New Construction Surveys, the classification of ships not built under Survey and Periodical Survey Regulations are given in *Pt 1, Ch 2 Classification Regulations* and *Pt 1, Ch 3 Periodical Survey Regulations* of the Rules for Ships. *Pt 1, Ch 3, 8 Special Survey - Chemical Tankers - Hull requirements* of the Rules for Ships deals specifically with the Periodical Survey regulations for ships for liquid chemicals. The following requirements are also to be complied with.

1.5.2.1 The structure, equipment, fittings, arrangements and material (other than items in respect of which a Cargo Ship Safety Construction Certificate, Cargo Ship Safety Equipment Certificate and Cargo Ship Safety Radio Certificate or Cargo Ship Safety Certificate are issued) of a chemical tanker shall be subjected to the following surveys:

(a) An initial survey before the ships is put in service or before the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk is issued for the first time, which shall include a complete examination of its structure,

equipment, fittings, arrangements and material in so far as the ship is covered by the Code. This survey shall be such as to ensure that the structure, equipment, fittings, arrangements and material fully comply with the applicable provisions of the Code.

(b) A renewal survey at intervals specified by the Administration, but not exceeding 5 years, except where *1.5.6 Duration and validity of International Certificate of Fitness*, *1.5.6 Duration and validity of International Certificate of Fitness*, *1.5.6 Duration and validity of International Certificate of Fitness* or *1.5.6 Duration and validity of International Certificate of Fitness* is applicable. The renewal survey shall be such as to ensure that the structure, equipment, fittings, arrangements and material fully comply with the applicable provisions of the Code.

(c) An intermediate survey within 3 months before or after the second anniversary date or within 3 months before or after the third anniversary date of the Certificate, which shall take the place of one of the annual surveys specified in *1.5.2 Survey requirements*. The intermediate survey shall be such as to ensure that the safety equipment, and other equipment, and associate pump and piping systems fully comply with the applicable provisions of the Code and are in good working order. Such intermediate surveys shall be endorsed on the Certificate issued under *1.5.4 Issue of International Certificate of Fitness* or *1.5.5 Issue or endorsement of International Certificate of Fitness by another Government*.

(d) An annual survey within 3 months before or after each anniversary date of the Certificate, including a general inspection of the structure, equipment, fittings, arrangements and material referred to in *1.5.2 Survey requirements* to ensure that they have been maintained in accordance with *1.5.3 Maintenance of conditions after survey* and that they remain satisfactory for the service for which the ship is intended. Such annual surveys shall be endorsed on the Certificate issued under *1.5.4 Issue of International Certificate of Fitness* or *1.5.5 Issue or endorsement of International Certificate of Fitness by another Government*.

(e) An additional survey, either general or partial according to the circumstances, shall be made when required after an investigation prescribed in *1.5.3 Maintenance of conditions after survey*, or whenever any important repairs or renewals are made. Such a survey shall ensure that the necessary repairs or renewals have been effectively made, that the material and workmanship of such repairs or renewals are satisfactory; and that the ship is fit to proceed to sea without danger to the ship or persons on board or without presenting unreasonable threat of harm to the marine environment.

LR 1.5.2(b) Particular reference is made to the following paragraphs in the Rules for Ships as applicable to chemical tankers:

Tank testing	*Pt 3, Ch 1, 8.3 Trial trip and operational tests* *Ch 12 Welding Qualifications* and *Ch 13 Requirements for Welded Construction* of the Rules for Materials
Welding	*Pt 3, Ch 10, 2.2 Fillet welds 2.2.7* *Pt 3, Ch 10, 2.2 Fillet welds 2.2.10* *Table 10.2.1 Weld factors*
Non-destructive Examination	*Ch 13, 2.12 Non-destructive examination of welds 2.12.4* of the Rules for Materials

1.5.3 Maintenance of conditions after survey

1.5.3.1 The conditions of the ship and its equipment shall be maintained to conform with the provisions of the Code to ensure that the ship will remain fit to proceed to sea without danger to the ship or persons on board or without presenting an unreasonable threat of harm to the marine environment.

1.5.3.2 After any survey of the ship under *1.5.2 Survey requirements* has been completed, no change shall be made in the structure, equipment, fittings, arrangements and material covered by the survey, without the sanction of the Administration, except by direct replacement.

1.5.3.3 Whenever an accident occurs to a ship or a defect is discovered, either of which affects the safety of the ship or the efficiency or completeness of its life-saving appliances or other equipment covered by the Code, the master or owner of the ship shall report at the earliest opportunity to the Administration, the nominated surveyor or recognized organization responsible for issuing the Certificate, who shall cause investigations to be initiated to determine whether a survey, as required by *1.5.2 Survey requirements*, is necessary. If the ship is in a port of another Contracting Government, the master or owner shall also report immediately to the appropriate authorities of the port State and the nominated surveyor or recognized organization shall ascertain that such a report has been made.

1.5.4 Issue of International Certificate of Fitness

1.5.4.1 An International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall be issued after an initial or renewal survey to a chemical tanker engaged in international voyages which complies with the relevant provisions of the Code.

1.5.4.2 Such a Certificate shall be drawn up in the form corresponding to the model given in the *Appendix Model Form of International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk*. If the language used is not English, French or Spanish, the text shall include the translation into one of these languages.

1.5.4.3 The Certificate issued under provisions of this section shall be available on board for examination at all times.

1.5.5 Issue or endorsement of International Certificate of Fitness by another Government

1.5.5.1 A Government that is both a Contracting Government to the *SOLAS - International Convention for the Safety of Life at Sea* and a Party to *MARPOL - International Convention for the Prevention of Pollution from Ships* may, at the request of another such Government, cause a ship entitled to fly the flag of the other State to be surveyed and, if satisfied that the provisions of the Code are complied with, issue or authorize the issue of the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk to the ship, and, where appropriate, endorse or authorize the endorsement of the Certificate on board the ship in accordance with the Code. Any Certificate so issued shall contain a statement to the effect that it has been issued at the request of the Government of the State whose flag the ship is entitled to fly.

1.5.6 Duration and validity of International Certificate of Fitness

1.5.6.1 An International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall be issued for a period specified by the Administration which shall not exceed 5 years.

1.5.6.2.1 Notwithstanding the provisions of *1.5.6 Duration and validity of International Certificate of Fitness*, when the renewal survey is completed within 3 months before the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding 5 years from the date of expiry of the existing Certificate.

1.5.6.2.2 When the renewal survey is completed after the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding 5 years from the date of expiry of the existing Certificate.

1.5.6.2.3 When the renewal survey is completed more than 3 months before the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding 5 years from the date of completion of the renewal survey.

1.5.6.3 If a Certificate is issued for a period of less than 5 years, the Administration may extend the validity of the Certificate beyond the expiry date to the maximum period specified in *1.5.6 Duration and validity of International Certificate of Fitness*, provided that the surveys referred to in *1.5.2 Survey requirements* and *1.5.2 Survey requirements*, applicable when a Certificate is issued for a period of 5 years, are carried out as appropriate.

1.5.6.4 If a renewal survey has been completed and a new Certificate cannot be issued or placed on board the ship before the expiry date of the existing Certificate, the person or organization authorized by the Administration may endorse the existing Certificate. Such a Certificate shall be accepted as valid for a further period which shall not exceed 5 months from the expiry date.

1.5.6.5 If a ship, at the time when a Certificate expires, is not in a port in which it is to be surveyed, the Administration may extend the period of validity of the Certificate but this extension shall be granted only for the purpose of allowing the ship to complete its voyage to the port in which it is to be surveyed, and then only in cases where it appears proper and reasonable to do so.

1.5.6.6 A Certificate, issued to a ship engaged on short voyages which has not been extended under the foregoing provisions of this section, may be extended by the Administration for a period of grace of up to one month from the date of expiry stated on it. When the renewal survey is completed, the new Certificate shall be valid to a date not exceeding 5 years from the date of expiry of the existing Certificate before the extension was granted.

1.5.6.7 In special circumstances, as determined by the Administration, a new Certificate need not be dated from the date of expiry of the existing Certificate as required by *1.5.6 Duration and validity of International Certificate of Fitness*, *1.5.6 Duration and validity of International Certificate of Fitness* or *1.5.6 Duration and validity of International Certificate of Fitness*. In these special circumstances, the new Certificate shall be valid to a date not exceeding 5 years from the date of completion of the renewal survey.

1.5.6.8 If an annual or intermediate survey is completed before the period specified in *1.5.2 Survey requirements*, then:

(a) the anniversary date shown on the Certificate shall be amended by endorsement to a date which shall not be more than 3 months later than the date on which the survey was completed;

(b) the subsequent annual or intermediate survey required by *1.5.2 Survey requirements* shall be completed at the intervals prescribed by that section using the new anniversary date; and

(c) the expiry date may remain unchanged provided one or more annual or intermediate surveys, as appropriate, are carried out so that the maximum intervals between the surveys prescribed by *1.5.2 Survey requirements* are not exceeded.

1.5.6.9 A Certificate issued under *1.5.4 Issue of International Certificate of Fitness* or *1.5.5 Issue or endorsement of International Certificate of Fitness by another Government* shall cease to be valid in any of the following cases:

(a) if the relevant surveys are not completed within the periods specified under *1.5.2 Survey requirements*;

(b) if the Certificate is not endorsed in accordance with *1.5.2 Survey requirements*or *1.5.2 Survey requirements*;

(c) upon transfer of the ship to the flag of another State. A new certificate shall only be issued when the Government issuing the new Certificate is fully satisfied that the ship is in compliance with the requirements of *1.5.3 Maintenance of conditions after survey* and *1.5.3 Maintenance of conditions after survey*. In the case of a transfer between Governments that are both a Contracting Government to the *SOLAS - International Convention for the Safety of Life at Sea* and a Party to *MARPOL - International Convention for the Prevention of Pollution from Ships*, if requested within 3 months after the transfer has taken place, the Government of the State whose flag the ship was formerly entitled to fly shall, as soon as possible, transmit to the Administration copies of the Certificate carried by the ship before the transfer and, if available, copies of the relevant survey reports.

Ship Survival Capability and Location of Cargo Tanks

2.1 General

LR 2.1(a) These requirements for Ship Survival Capability are not classification requirements. However, in cases where LR is authorised to issue the relevant Statutory Certificates, and is requested to do so, the requirements of this Chapter will be applied together with any amendment or interpretation adopted by the appropriate National Authority, *see also LR II.2 Ship survival capability, fire protection and fire-extinction and operational requirements*.

2.1.1 Ships, subject to the Code, shall survive the normal effects of flooding following assumed hull damage caused by some external force. In addition, to safeguard the ship and the environment, the cargo tanks of certain types of ships shall be protected from penetration in the case of minor damage to the ship resulting, for example, from contact with a jetty or tug, and given a measure of protection from damage in the case of collision or stranding, by locating them at specified minimum distances inboard from the ship's shell plating. Both the assumed damage and the proximity of the cargo tanks to the ship's shell shall be dependent upon the degree of hazard presented by the products to be carried.

2.1.2 Ships subject to the Code shall be designed to one of the following standards:

(a) A type 1 ship is a chemical tanker intended to transport *chapter 17* products with very severe environmental and safety hazards which require maximum preventive measures to preclude an escape of such cargo.

(b) A type 2 ship is a chemical tanker intended to transport *chapter 17* products with appreciably severe environmental and safety hazards which require significant preventive measures to preclude an escape of such cargo.

(c) A type 3 ship is a chemical tanker intended to transport *chapter 17* products with sufficiently severe environmental and safety hazards which require a moderate degree of containment to increase survival capability in a damaged condition.

Thus, a type 1 ship is a chemical tanker intended for the transportation of products considered to present the greatest overall hazard and type 2 and type 3 for products of progressively lesser hazards. Accordingly, a type 1 ship shall survive the most severe standard of damage and its cargo tanks shall be located at the maximum prescribed distance inboard from the shell plating.

2.1.3 The ship type required for individual products is indicated in *column e* in the table of *chapter 17*.

2.1.4 If a ship is intended to carry more than one product listed in *chapter 17*, the standard of damage shall correspond to that product having the most stringent ship type requirement. The requirements for the location of individual cargo tanks, however, are those for ship types related to the respective products intended to be carried.

2.2 Freeboard and intact stability

2.2.1 Ships subject to the Code may be assigned the minimum freeboard permitted by the International Convention on Load Lines in force. However, the draught associated with the assignment shall not be greater than the maximum draught otherwise permitted by this Code.

2.2.2 The stability of the ship in all seagoing conditions shall be to a standard which is acceptable to the Administration.

2.2.3 When calculating the effect of free surfaces of consumable liquids for loading conditions it shall be assumed that, for each type of liquid, at least one transverse pair or a single centre tank has a free surface and the tank or combination of tanks to be taken into account shall be those where the effect of free surfaces is the greatest. The free surface effect in undamaged compartments shall be calculated by a method acceptable to the Administration.

2.2.4 Solid ballast shall not normally be used in double-bottom spaces in the cargo area. Where, however, because of stability considerations, the fitting of solid ballast in such spaces becomes unavoidable, then its disposition shall be governed by the need to ensure that the impact loads resulting from bottom damage are not directly transmitted to the cargo tank structure.

2.2.5 The master of the ship shall be supplied with a loading and stability information booklet. This booklet shall contain details of typical service and ballast conditions, provisions for evaluating other conditions of loading and a summary of the ship's survival capabilities. In addition, the booklet shall contain sufficient information to enable the master to load and operate the ship in a safe and seaworthy manner.

2.3 Shipside discharges below the freeboard deck

2.3.1 The provision and control of valves fitted to discharges led through the shell from spaces below the freeboard deck or from within the super-structures and deck-houses on the freeboard deck fitted with weathertight doors shall comply with the requirements of the relevant regulation of the International Convention on Load Lines in force, except that the choice of valves shall be limited to:

(a) one automatic non-return valve with a positive means of closing from above the freeboard deck; or

(b) where the vertical distance from the summer load waterline to the inboard end of the discharge pipe exceeds 0.01L, two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination under service conditions.

2.3.2 For the purpose of this chapter, "summer load line" and "freeboard deck" have the meanings as defined in the *Load Lines, 1966/1988 - International Convention on Load Lines, 1966, as Amended by the Protocol of 1988* in force.

2.3.3 The automatic non-return valves referred to in *Ch 1, 2.3 Shipside discharges below the freeboard deck 2.3.1* and *Ch 1, 2.3 Shipside discharges below the freeboard deck 2.3.1.(b)* shall be fully effective in preventing admission of water into the ship, taking into account the sinkage, trim and heel in survival requirements in *Ch 1, 2.9 Survival requirements*, and shall comply with recognized standards.

2.4 Conditions of loading

2.4.1 Damage survival capability should be investigated on the basis of loading information submitted to the Administration for all anticipated conditions of loading and variations in draught and trim. Ballast conditions where the chemical tanker is not carrying products covered by the Code, or is carrying only residues of such products, need not be considered.

2.5 Damage assumptions

2.5.1 The assumed maximum extent of damage shall be:

.1	**Side damage:**		
.1.1	Longitudinal extent:	$1/3L^{2/3}$ or 14.5 m, whichever is less	
.1.2	Transverse extent:	B/5 or 11.5 m, whichever is less (measured inboard from the ship's side at right angles to the centreline at the level of the summer load line)	
.1.3	Vertical extent:	upwards without limit (measured from the moulded line of the bottom shell plating at centreline)	
.2	**Bottom damage:**	**For 0.3L from the forward perpendicular of the ship**	**Any other part of the ship**
.2.1	Longitudinal extent	$1/3L^{2/3}$ or 14.5 m, whichever is less	$1/3L^{2/3}$ or 5 m, whichever is less

.2.2	Transverse extent:	B/6 or 10 m, whichever is less	B/6 or 5 m, whichever is less
.2.3	Vertical extent:	B/15 or 6 m, whichever is less [measured from the moulded line of the bottom shell plating at centreline (see *Ch 1, 2.6 Location of cargo tanks 2.6.2*)]	B/15 or 6 m, whichever is less [measured from the moulded line of the bottom shell plating at centreline (see *Ch 1, 2.6 Location of cargo tanks 2.6.2*)]

2.5.2 If any damage of a lesser extent than the maximum damage specified in *Ch 1, 2.5 Damage assumptions 2.5.1* would result in a more severe condition, such damage shall be considered.

2.6 Location of cargo tanks

2.6.1 Cargo tanks shall be located at the following distances inboard:

(a) Type 1 ships: from the side shell plating, not less than the transverse extent of damage specified in *Ch 1, 2.5 Damage assumptions*, and from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in *Ch 1, 2.5 Damage assumptions*, and nowhere less than 760 mm from the shell plating. This requirement does not apply to the tanks for diluted slops arising from tank washing.

(b) Type 2 ships: from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in *Ch 1, 2.5 Damage assumptions*, and nowhere less than 760 mm from the shell plating. This requirement does not apply to the tanks for diluted slops arising from tank washing.

(c) Type 3 ships: no requirement.

2.6.2 Except for type 1 ships, suction wells installed in cargo tanks may protrude into the vertical extent of bottom damage specified in *Ch 1, 2.5 Damage assumptions* provided that such wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom or 350 mm, whichever is less. Where there is no double bottom, the protrusion of the suction well of independent tanks below the upper limit of bottom damage shall not exceed 350 mm. Suction wells installed in accordance with this paragraph may be ignored in determining the compartments affected by damage.

2.7 Flooding assumptions

2.7.1 The requirements of *Ch 1, 2.9 Survival requirements* shall be confirmed by calculations which take into consideration the design characteristics of the ship; the arrangements, configuration and contents of the damaged compartments; the distribution, relative densities and the free surface effects of liquids; and the draught and trim for all conditions of loading.

2.7.2 The permeabilities of spaces assumed to be damaged shall be as follows:

Spaces	**Permeabilities**
Appropriated to stores	0.60
Occupied by accommodation	0.95
Occupied by machinery	0.85
Voids	0.95
Intended for consumable liquids	0 to 0.95[2]
Intended for other liquids	0 to 0.95[2]

2.7.3 Wherever damage penetrates a tank containing liquids it shall be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

2.7.4 Every watertight division within the maximum extent of damage defined in *Ch 1, 2.5 Damage assumptions 2.5.1* and considered to have sustained damage in positions given in *Ch 1, 2.8 Standard of damage 2.8.1* shall be assumed to be penetrated. Where damage less than the maximum is being considered in accordance with *Ch 1, 2.5 Damage assumptions 2.5.2*, only watertight divisions or combinations of watertight divisions within the envelope of such lesser damage shall be assumed to be penetrated.

2.7.5 The ship shall be so designed as to keep unsymmetrical flooding to the minimum consistent with efficient arrangements.

[2] The permeability of partially filled compartments shall be consistent with the amount of liquid carried in the compartment.

2.7.6 Equalization arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, shall not be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the requirements of *Ch 1, 2.9 Survival requirements* and sufficient residual stability shall be maintained during all stages where equalization is used. Spaces which are linked by ducts of large cross-sectional area may be considered to be common.

2.7.7 If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage penetration, as defined in *Ch 1, 2.5 Damage assumptions*, arrangements shall be such that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage.

2.7.8 The buoyancy of any superstructure directly above the side damage shall be disregarded. The unflooded parts of superstructures beyond the extent of damage, however, may be taken into consideration provided that:

(a) they are separated from the damaged space by watertight divisions and the requirements of *Ch 1, 2.9 Survival requirements 2.9.3* in respect of these intact spaces are complied with; and

(b) openings in such divisions are capable of being closed by remotely operated sliding watertight doors and unprotected openings are not immersed within the minimum range of residual stability required in *Ch 1, 2.9 Survival requirements*; however, the immersion of any other openings capable of being closed weathertight may be permitted.

2.8 Standard of damage

2.8.1 Ships shall be capable of surviving the damage indicated in *Ch 1, 2.5 Damage assumptions* with the flooding assumptions in *Ch 1, 2.7 Flooding assumptions* to the extent determined by the ship's type according to the following standards:

(a) A type 1 ship shall be assumed to sustain damage anywhere in its length.

(b) A type 2 ship of more than 150 m in length shall be assumed to sustain damage anywhere in its length.

(c) A type 2 ship of 150 m in length or less shall be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft.

(d) A type 3 ship of more than 225 m in length shall be assumed to sustain damage anywhere in its length.

(e) A type 3 ship of 125 m in length or more but not exceeding 225 m in length shall be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft.

(f) A type 3 ship below 125 m in length shall be assumed to sustain damage anywhere in its length except involving damage to the machinery space when located aft. However, the ability to survive the flooding of the machinery space shall be considered by the Administration.

2.8.2 In the case of small type 2 and type 3 ships which do not comply in all respects with the appropriate requirements of *Ch 1, 2.8 Standard of damage 2.8.1.(c)* and *Ch 1, 2.8 Standard of damage 2.8.1.(f)*, special dispensation may only be considered by the Administration provided that alternative measures can be taken which maintain the same degree of safety. The nature of the alternative measures shall be approved and clearly stated and be available to the port Administration. Any such dispensation shall be duly noted on the International Certificate of Fitness referred to in *1.5.4 Issue of International Certificate of Fitness*.

2.9 Survival requirements

2.9.1 Ships subject to the Code shall be capable of surviving the assumed damage specified in *Ch 1, 2.5 Damage assumptions* to the standard provided in *Ch 1, 2.8 Standard of damage* in a condition of stable equilibrium and should satisfy the following criteria.

2.9.2 In any stage of flooding:

(a) The waterline, taking into account sinkage, heel and trim, shall be below the lower edge of any opening through which progressive flooding or downflooding may take place. Such openings shall include air pipes and openings which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and watertight flush scuttles, small watertight cargo-tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type;

(b) the maximum angle of heel due to unsymmetrical flooding shall not exceed 25°, except that this angle may be increased to 30° if no deck immersion occurs;

(c) the residual stability during intermediate stages of flooding shall be to the satisfaction of the Administration. However, it shall never be significantly less than that required by *Ch 1, 2.9 Survival requirements 2.9.3*.

2.9.3 At final equilibrium after flooding:

(a) the righting-lever curve shall have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range should not be less than 0.0175 m rad. Unprotected openings should not be immersed within this range unless the space concerned is assumed to

be flooded. Within this range, the immersion of any of the openings listed in *Ch 1, 2.9 Survival requirements 2.9.2* and other openings capable of being closed weathertight may be permitted; and

(b) the emergency source of power shall be capable of operating.

Ship Arrangements

3.1 Cargo segregation

3.1.1 Unless expressly provided otherwise, tanks containing cargo or residues of cargo subject to the Code shall be segregated from accommodation, service and machinery spaces and from drinking water and stores for human consumption by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, fuel oil tank or other similar space.

LR 3.1(a) Segregation of cargo tanks from spaces which are intended to be non-hazardous, where diagonal or corner to corner situations may occur, will require to be specially considered. *See also Pt 4, Ch 9, 1.2 Application and ship arrangement 1.2.9* of the Rules for Ships.

3.1.2 Cargo piping shall not pass through any accommodation, service or machinery space other than cargo pump-rooms or pump-rooms.

3.1.3 Cargoes, residues of cargoes or mixtures containing cargoes, which react in a hazardous manner with other cargoes, residues or mixtures, shall:

(a) be segregated from such other cargoes by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or tank containing a mutually compatible cargo;

(b) have separate pumping and piping systems which shall not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and

(c) have separate tank venting systems.

3.1.4 If cargo piping systems or cargo ventilation systems are to be separated. This separation may be achieved by the use of design or operational methods. Operational methods shall not be used within a cargo tank and shall consist of one of the following types:

(a) removing spool-pieces or valves and blanking the pipe ends;

(b) arrangement of two spectacle flanges in series, with provisions for detecting leakage into the pipe between the two spectacle flanges.

3.1.5 Cargoes subject to the Code shall not be carried in either the fore or aft peak tank.

LR 3.1(b) The cargoes referred to in *Ch 1, 3.1 Cargo segregation 3.1.1*, *Ch 1, 3.1 Cargo segregation 3.1.2* and *Ch 1, 3.1 Cargo segregation 3.1.4* for the purpose of these Rules are those listed in *Chapter 17*, or those cargoes referred to in paragraph 4 of the *Preamble*.

3.2 Accommodation, service and machinery spaces and control stations

3.2.1 No accommodation or service spaces or control stations shall be located within the cargo area except over a cargo pump-room recess or pump-room recess that complies with SOLAS *Regulation 4 - Probability of ignition* and no cargo or slop tank shall be aft of the forward end of any accommodation.

LR 3.2(a) Accommodation or service spaces or control stations may be situated over an fuel oil tank having a common boundary to a cargo or slop tank provided all other relevant requirements of these Rules and the *Rules and Regulations for the Classification of Ships, July 2017* are complied with.

3.2.2 In order to guard against the danger of hazardous vapours, due consideration shall be given to the location of air intakes and openings into accommodation, service and machinery spaces and control stations in relation to cargo piping and cargo vent systems.

LR 3.2(b) Compliance with *Ch 1, 3.2 Accommodation, service and machinery spaces and control stations 3.2.1*, *Ch 1, 3.2 Accommodation, service and machinery spaces and control stations 3.2.3*, *Ch 1, 3.7 Bow or stern loading and unloading arrangements*, *Ch 1, 5.2 Piping fabrication and joining details*, *Ch 1, 8.2 Cargo tank venting 8.2.2*, *Ch 1, 12.1 Spaces normally entered during cargo-handling operations 12.1.5* and *Ch 1, 15.12 Toxic products*, where applicable, will also satisfy the requirements of *Ch 1, 3.2 Accommodation, service and machinery spaces and control stations 3.2.2*.

3.2.3 Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations shall not face the cargo area. They shall be located on the end bulkhead not facing the cargo area and/or on the outboard side of the superstructure or deck-house at a distance of at least 4% of the length (L) of the ship but not less than 3 m from the end of the superstructure or deck-house facing the cargo area. This distance, however, need not exceed 5 m. No doors shall be permitted within the limits mentioned above, except that doors to those spaces not having access to accommodation and service spaces and control stations, such as cargo control stations and store-rooms, may be fitted. Where such doors are fitted, the boundaries of the space shall be insulated to "A-60" standard. Bolted plates for removal of machinery may be fitted within the limits specified above. Wheelhouse doors and wheelhouse windows may be located within the limits specified above so long as they are so designed that a rapid and efficient gas- and vapour-tightening of the wheelhouse can be ensured. Windows and sidescuttles facing the cargo area and on the sides of the superstructures and deck-houses within the limits specified above shall be of the fixed (non-opening) type. Such sidescuttles in the first tier on the main deck shall be fitted with inside covers of steel or equivalent material.

LR 3.2(c) Spaces such as cargo control stations and store rooms not having access to accommodation and service spaces and control stations, as specified in *Ch 1, 3.2 Accommodation, service and machinery spaces and control stations 3.2.3* are to be provided with mechanical ventilation as per *Chapter 12*, as appropriate to the designated use. Instructions are to be posted for gas-freeing prior to entry.

3.3 Cargo pump-rooms

3.3.1 Cargo pump-rooms shall be so arranged as to ensure:

(a) unrestricted passage at all times from any ladder platform and from the floor; and

(b) unrestricted access to all valves necessary for cargo handling for a person wearing the required personnel protective equipment.

3.3.2 Permanent arrangements shall be made for hoisting an injured person with a rescue line while avoiding any projecting obstacles.

3.3.3 Guard railings shall be installed on all ladders and platforms.

3.3.4 Normal access ladders shall not be fitted vertical and shall incorporate platforms at suitable intervals.

3.3.5 Means shall be provided to deal with drainage and any possible leakage from cargo pumps and valves in cargo pump-rooms. The bilge system serving the cargo pump-room shall be operable from outside the cargo pump-room. One or more slop tanks for storage of contaminated bilge water or tank washings shall be provided. A shore connection with a standard coupling or other facilities shall be provided for transferring contaminated liquids to onshore reception facilities.

LR 3.3(a) All shut-off valves incorporated in bilge systems are to be operable from outside the cargo pump-room. Any suitable cargo tank may be used as a slop tank.

3.3.6 Pump discharge pressure gauges shall be provided outside the cargo pump-room.

LR 3.3(b) For the purpose of *Ch 1, 3.3 Cargo pump-rooms 3.3.6* the definition of cargo pump-room is to include any cargo pump-room entrance spaces. *See also Ch 1, 1.3 Definitions 1.3.6*.

3.3.7 Where machinery is driven by shafting passing through a bulkhead or deck, gastight seals with efficient lubrication or other means of ensuring the permanence of the gas seal shall be fitted in way of the bulkhead or deck.

LR 3.3(c) The gastight glands are to be of an approved type and lubricated from outside the pumproom. *See Pt 5, Ch 15, 3.2 Cargo pumps* of the Rules for Ships.

3.4 Access to spaces in the cargo area

3.4.1 Access to cofferdams, ballast tanks, cargo tanks and other spaces in the cargo area shall be direct from the open deck and such as to ensure their complete inspection. Access to double-bottom spaces may be through a cargo pump-room, pump-room, deep cofferdam, pipe tunnel or similar compartments, subject to consideration of ventilation aspects.

LR 3.4(a) Spaces which are of confined or cellular construction adjacent to cargo or slop tanks such as double bottom tanks and cofferdams are to have dual access from the upper deck, spaced as widely apart as possible. Pipe tunnels and duct keels to which access is normally required for operational purposes, are to be provided with means of access not more than 60 m apart. In all cases, however, access is to be provided at each end of the tunnel or duct keel.

3.4.2 For access through horizontal openings, hatches or manholes, the dimensions shall be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction

and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening shall be not less than 600 mm by 600 mm.

3.4.3 For access through vertical openings, or manholes providing passage through the length and breadth of the space, the minimum clear opening shall be not less than 600 mm by 800 mm at a height of not more than 600 mm from the bottom shell plating unless gratings or other footholds are provided.

3.4.4 Smaller dimensions may be approved by the Administration in special circumstances, if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Administration.

LR 3.4(b) When dimensions of openings smaller than those required in *Ch 1, 3.4 Access to spaces in the cargo area 3.4.2* and *Ch 1, 3.4 Access to spaces in the cargo area 3.4.3* are found to be unavoidable, equivalent area should be obtained wherever practicable. Where this cannot be achieved, openings should be as large as practicable and suitable additional operational procedures for gas-freeing before entry (such as flooding and emptying of double bottom tanks) should be submitted for consideration.

3.5 Bilge and ballast arrangements

3.5.1 Pumps, ballast lines, vent lines and other similar equipment serving permanent ballast tanks shall be independent of similar equipment serving cargo tanks and of cargo tanks themselves. Discharge arrangements for permanent ballast tanks sited immediately adjacent to cargo tanks shall be outside machinery spaces and accommodation spaces. Filling arrangements may be in the machinery spaces provided that such arrangements ensure filling from tank deck level and non-return valves are fitted.

3.5.2 Filling of ballast in cargo tanks may be arranged from deck level by pumps serving permanent ballast tanks, provided that the filling line has no permanent connection to cargo tanks or piping and that non-return valves are fitted.

LR 3.5(a) The ballast pump referred to is to be located outside the machinery and accommodation spaces and in most cases would be located in a below deck cargo or ballast pump-room. The connection to the cargo tank is to be made by means of a removable pipe length and the filling pipe is to be fitted with isolating and non-return valves and led to as low a level as practicable within the tank.

3.5.3 Bilge pumping arrangements for cargo pump-rooms, pump-rooms, void spaces, slop tanks, double-bottom tanks and similar spaces shall be situated entirely within the cargo area except for void spaces, double-bottom tanks and ballast tanks where such spaces are separated from tanks containing cargo or residues of cargo by a double bulkhead.

3.6 Pump and pipeline identification

3.6.1 Provisions shall be made for the distinctive marking of pumps, valves and pipelines to identify the service and tanks which they serve.

3.7 Bow or stern loading and unloading arrangements

3.7.1 Cargo piping may be fitted to permit bow or stern loading and unloading. Portable arrangements shall not be permitted.

3.7.2 Bow or stern loading and unloading lines shall not be used for the transfer of products required to be carried in type 1 ships. Bow and stern loading and unloading lines shall not be used for the transfer of cargoes emitting toxic vapours required to comply with *Ch 1, 15.12 Toxic products 15.12.1*, unless specifically approved by the Administration.

3.7.3 In addition to *Ch 1, 5.1 Piping scantlings*, the following provisions apply:

(a) The piping outside the cargo area shall be fitted at least 760 mm inboard on the open deck. Such piping shall be clearly identified and fitted with a shutoff valve at its connection to the cargo piping system within the cargo area. At this location, it shall also be capable of being separated by means of a removable spool-piece and blank flanges when not in use.

(b) The shore connection shall be fitted with a shutoff valve and a blank flange.

(c) The piping shall be full-penetration butt-welded, and fully radiographed. Flange connections in the piping shall only be permitted within the cargo area and at the shore connection.

(d) Spray shields shall be provided at the connections specified in *Ch 1, 3.7 Bow or stern loading and unloading arrangements 3.7.3* as well as collecting trays of sufficient capacity, with means for the disposal of drainage.

(e) The piping shall be self-draining to the cargo area and preferably into a cargo tank. Alternative arrangements for draining the piping may be accepted by the Administration.

(f) Arrangements shall be made to allow such piping to be purged after use and maintained gas-safe when not in use. The vent pipes connected with the purge shall be located in the cargo area. The relevant connections to the piping shall be provided with a shutoff valve and blank flange.

3.7.4 Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations shall not face the cargo shore-connection location of bow or stern loading and unloading arrangements. They shall be located on the outboard side of the superstructure or deck-house at a distance of at least 4% of the length of the ship but not less than 3 m from the end of the house facing the cargo shore-connection location of the bow or stern loading and unloading arrangements. This distance, however, need not exceed 5 m. Sidescuttles facing the shore-connection location and on the sides of the superstructure or deck-house within the distance mentioned above shall be of the fixed (non-opening) type. In addition, during the use of the bow or stern loading and unloading arrangements, all doors, ports and other openings on the corresponding superstructure or deck-house side shall be kept closed. Where, in the case of small ships, compliance with *Ch 1, 3.2 Accommodation, service and machinery spaces and control stations 3.2.3* and this paragraph is not possible, the Administration may approve relaxations from the above requirements.

3.7.5 Air pipes and other openings to enclosed spaces not listed in *Ch 1, 3.7 Bow or stern loading and unloading arrangements 3.7.4* shall be shielded from any spray which may come from a burst hose or connection.

3.7.6 Escape routes shall not terminate within the coamings required by *Ch 1, 3.7 Bow or stern loading and unloading arrangements 3.7.7* or within a distance of 3 m beyond the coamings.

3.7.7 Continuous coamings of suitable height shall be fitted to keep any spills on deck and away from the accommodation and service areas.

3.7.8 Electrical equipment within the coamings required by *Ch 1, 3.7 Bow or stern loading and unloading arrangements 3.7.7* or within a distance of 3 m beyond the coamings shall be in accordance with the requirements of *chapter 10*.

3.7.9 Fire-fighting arrangements for the bow or stern loading and unloading areas shall be in accordance with *Ch 1, 11.3 Cargo area 11.3.16*.

3.7.10 Means of communication between the cargo control station and the cargo shore-connection location shall be provided and certified safe, if necessary. Provision shall be made for the remote shutdown of cargo pumps from the cargo shore-connection location.

Cargo Containment

4.1 Definitions

4.1.1 *Independent tank* means a cargo-containment envelope, which is not contiguous with, or part of, the hull structure. An independent tank is built and installed so as to eliminate whenever possible (or in any event to minimize) its stressing as a result of stressing or motion of the adjacent hull structure. An independent tank is not essential to the structural completeness of the ship's hull.

4.1.2 *Integral tank* means a cargo-containment envelope which forms part of the ship's hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the ship's hull.

4.1.3 *Gravity tank* means a tank having a design pressure not greater than 0.07 MPa gauge at the top of the tank. A gravity tank may be independent or integral. A gravity tank shall be constructed and tested according to recognized standards, taking account of the temperature of carriage and relative density of the cargo.

4.1.4 *Pressure tank* means a tank having a design pressure greater than 0.07 MPa gauge. A pressure tank shall be an independent tank and shall be of a configuration permitting the application of pressure-vessel design criteria according to recognized standards.

LR 4.1(a) Integral tank scantlings and arrangements

LR 4.1(a).1 Integral cargo tank scantlings and arrangements are to be in accordance with *Chapter LR V*.

LR 4.1(b) Independent tank scantlings and arrangements

LR 4.1(b).1 The scantlings and arrangements will be considered on the basis of the standards contained in the Rules for Ships for Liquefied Gases, taking account of the cargo relative densities.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

LR 4.1(b).2 Consideration is to be given to the maximum pressure which will be encountered in service and account is to be taken of the dynamic loading which will be experienced by the tanks, supports and keys. Calculations are to be submitted to enable the appraisal of the proposed arrangements.

LR 4.1(b).3 Where it is intended to carry high temperature cargoes, the tanks are to be supported and keyed so as to permit free expansion in all directions and eliminate heat bridges which may transmit thermal stresses to the hull of the ship.

LR 4.1(b).4 All openings should be in the top of the tank and extended above the deck. Access is to be from the open deck direct with arrangements for maintaining watertightness at the joint between the hatch coaming and the deck.

4.2 Tank type requirements for individual products

4.2.1 Requirements for both installation and design of tank types for individual products are shown in *column f* in the table of *chapter 17*.

Cargo Transfer

5.1 Piping scantlings

5.1.1 Subject to the conditions stated in *Ch 1, 5.1 Piping scantlings* the wall thickness (t) of pipes shall not be less than:

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}} (mm)$$

where:

t_0 = theoretical thickness

= $t_o = PD/(2Ke + P)(mm)$

with

P = design pressure (MPa) referred to in *Ch 1, 5.1 Piping scantlings*

D = outside diameter (mm)

K = allowable stress (N/mm^2) referred to in *Ch 1, 5.1 Piping scantlings*

e = efficiency factor equal to 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, which are considered equivalent to seamless pipes when non-destructive testing on welds is carried out in accordance with recognized standards. In other cases, an efficiency factor of less than 1.0, in accordance with recognized standards, may be required depending on the manufacturing process.

b = allowance for bending (mm). The value of b shall be chosen so that the calculated stress in the bend, due to internal pressure only, does not exceed the allowable stress. Where such justification is not given, b shall be not less than:

= $b = \frac{Dt_0}{2.5r} (mm)$

with

r = mean radius of the bend (mm).

c = corrosion allowance (mm). If corrosion or erosion is expected, the wall thickness of piping shall be increased over that required by the other design requirements.

a = negative manufacturing tolerance for thickness (%).

5.1.2 The design pressure P in the formula for t_o in *Ch 1, 5.1 Piping scantlings* is the maximum gauge pressure to which the system may be subjected in service, taking into account the highest set pressure on any relief valve on the system.

5.1.3 Piping and piping-system components which are not protected by a relief valve, or which may be isolated from their relief valve, shall be designed for at least the greatest of:

(a) for piping systems or components, which may contain some liquid, the saturated vapour pressure at 45°C;
(b) the pressure setting of the associated pump discharge relief valve;
(c) the maximum possible total pressure head at the outlet of the associated pumps when a pump discharge relief valve is not installed.

5.1.4 The design pressure shall not be less than 1 MPa gauge except for open-ended lines, where it shall be not less than 0.5 MPa gauge.

5.1.5 For pipes, the allowable stress K to be considered in the formula for t_o in *Ch 1, 5.1 Piping scantlings* is the lower of the following values:

$$\frac{Rm}{A} \text{ or } \frac{R_e}{B}$$

where:

R_m = specified minimum tensile strength at ambient temperature (N/mm^2)

R_e = specified minimum yield stress at ambient temperature (N/mm^2). If the stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies.

A and B shall have values of at least A = 2.7 and B = 1.8.

5.1.6.1 The minimum wall thickness shall be in accordance with recognized standards.

LR 5.1(a) The nominal thickness of steel pipes is to be not less than shown in *Table 12.2.4 Minimum thickness for steel pipes* in Pt 5, Ch 12 of the Rules for Ships.

LR 5.1(b) Stainless steel pipes will receive special consideration.

5.1.6.2 Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to weight of pipes and content and to superimposed loads from supports, ship deflection or other causes, the wall thickness shall be increased over that required by *Ch 1, 5.1 Piping scantlings* or, if this is impracticable or would cause excessive local stresses, these loads shall be reduced, protected against or eliminated by other design methods.

5.1.6.3 Flanges, valves and other fittings shall be in accordance with recognized standards, taking into account the design pressure defined under *Ch 1, 5.1 Piping scantlings*.

5.1.6.4 For flanges not complying with a standard, the dimensions for flanges and associated bolts shall be to the satisfaction of the Administration.

5.2 Piping fabrication and joining details

5.2.1 The requirements of this section apply to piping inside and outside the cargo tanks. However, relaxations from these requirements may be accepted in accordance with recognized standards for open-ended piping and for piping inside cargo tanks except for cargo piping serving other cargo tanks.

5.2.2 Cargo piping shall be joined by welding except:

(a) for approved connections to shutoff valves and expansion joints; and
(b) for other exceptional cases specifically approved by the Administration.

5.2.3 The following direct connections of pipe lengths without flanges may be considered:

(a) Butt-welded joints with complete penetration at the root may be used in all applications.
(b) Slip-on welded joints with sleeves and related welding having dimensions in accordance with recognized standards shall only be used for pipes with an external diameter of 50 mm or less. This type of joint shall not be used when crevice corrosion is expected to occur.
(c) Screwed connections, in accordance with recognized standards, shall only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less.

5.2.4 Expansion of piping shall normally be allowed for by the provision of expansion loops or bends in the piping system.

(a) Bellows, in accordance with recognized standards, may be specially considered.
(b) Slip joints shall not be used.

5.2.5 Welding, post-weld heat treatment and non-destructive testing shall be performed in accordance with recognized standards.

LR 5.2(a) Welding, post heat treatment and non-destructive examination is also to be in accordance with the requirements of *Ch 13 Requirements for Welded Construction* of the Rules for Materials.

5.3 Flange connections

5.3.1 Flanges shall be of the welded-neck, slip-on or socket-welded type. However, socket-welded-type flanges shall not be used in nominal size above 50 mm.

5.3.2 Flanges shall comply with recognized standards as to their type, manufacture and test.

5.4 Test requirements for piping

5.4.1 The test requirements of this section apply to piping inside and outside cargo tanks. However, relaxations from these requirements may be accepted in accordance with recognized standards for piping inside tanks and open-ended piping.

5.4.2 After assembly, each cargo piping system shall be subject to a hydrostatic test to at least 1.5 times the design pressure. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the hydrostatic test may be conducted prior to installation aboard the ship. Joints welded on board shall be hydrostatically tested to at least 1.5 times the design pressure.

5.4.3 After assembly on board, each cargo piping system shall be tested for leaks to a pressure depending on the method applied.

5.5 Piping arrangements

5.5.1 Cargo piping shall not be installed under deck between the out-board side of the cargo-containment spaces and the skin of the ship unless clearances required for damage protection (see *Ch 1, 2.6 Location of cargo tanks*) are maintained; but such distances may be reduced where damage to the pipe would not cause release of cargo provided that the clearance required for inspection purposes is maintained.

5.5.2 Cargo piping located below the main deck may run from the tank it serves and penetrate tank bulkheads or boundaries common to longitudinally or transversally adjacent cargo tanks, ballast tanks, empty tanks, pump-rooms or cargo pump-rooms provided that inside the tank it serves it is fitted with a stop-valve operable from the weather deck and provided cargo compatibility is assured in the event of piping failure. As an exception, where a cargo tank is adjacent to a cargo pump-room, the stop valve operable from the weather deck may be situated on the tank bulkhead on the cargo pump-room side, provided an additional valve is fitted between the bulkhead valve and the cargo pump. A totally enclosed hydraulically operated valve located outside the cargo tank may, however, be accepted, provided that the valve is:

(a) designed to preclude the risk of leakage;
(b) fitted on the bulkhead of the cargo tank which it serves;
(c) suitably protected against mechanical damage;
(d) fitted at a distance from the shell as required for damage protection; and
(e) operable from the weather deck.

5.5.3 In any cargo pump-room where a pump serves more than one tank, a stop valve shall be fitted in the line to each tank.

5.5.4 Cargo piping installed in pipe tunnels shall also comply with the requirements of *Ch 1, 5.5 Piping arrangements 5.5.1* and *Ch 1, 5.5 Piping arrangements 5.5.2*. Pipe tunnels shall satisfy all tank requirements for construction, location and ventilation and electrical hazard requirements. Cargo compatibility shall be assured in the event of a piping failure. The tunnel shall not have any other openings except to the weather deck and cargo pump-room or pump-room.

5.5.5 Cargo piping passing through bulkheads shall be so arranged as to preclude excessive stresses at the bulkhead and shall not utilize flanges bolted through the bulkhead.

5.6 Cargo transfer control systems

5.6.1 For the purpose of adequately controlling the cargo, cargo-transfer systems shall be provided with:

(a) one stop-valve capable of being manually operated on each tank filling and discharge line, located near the tank penetration; if an individual deepwell pump is used to discharge the contents of a cargo tank, a stop-valve is not required on the discharge line of that tank;
(b) one stop valve at each cargo-hose connection;
(c) remote shutdown devices for all cargo pumps and similar equipment.

LR 5.6(a) Standby means for pumping out each cargo tank are to be provided. *See Pt 5, Ch 15, 3.1 General 3.1.2* of the Rules for Ships.

5.6.2 The controls necessary during transfer or transport of cargoes covered by the Code other than in cargo pump-rooms which have been dealt with elsewhere in the Code shall not be located below the weather deck.

5.6.3 For certain products, additional cargo-transfer control requirements are shown in *column o* in the table of *chapter 17*.

5.7 Ship's cargo hoses

5.7.1 Liquid and vapour hoses used for cargo transfer shall be compatible with the cargo and suitable for the cargo temperature.

LR 5.7(a) Details of such hoses are to be submitted together with a type test certificate issued by a recognized Authority.

5.7.2 Hoses subject to tank pressure or the discharge pressure of pumps shall be designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer.

5.7.3 For cargo hoses installed on board ships on or after 1 July 2002, each new type of cargo hose, complete with end-fittings, shall be prototype-tested at a normal ambient temperature with 200 pressure cycles from zero to at least twice the specified maximum working pressure. After this cycle pressure test has been carried out, the prototype test shall demonstrate a bursting pressure of at least 5 times its specified maximum working pressure at the extreme service temperature. Hoses used for prototype testing shall not be used for cargo service. Thereafter, before being placed in service, each new length of cargo hose produced shall be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure but not more than two-fifths of its bursting pressure. The hose shall be stencilled or otherwise marked with the date of testing, its specified maximum working pressure and, if used in services other than the ambient temperature services, its maximum and minimum service temperature, as applicable. The specified maximum working pressure shall not be less than 1 MPa gauge.

LR 5.7(b) The term 'extreme' in the eighth line of the above refers to the highest and/or lowest service temperature for which the hose is intended.

Materials of Construction and welding

6.1 Materials of construction and welding

6.1 Structural materials used for tank construction, together with associated piping, pumps, valves, vents and their jointing materials, shall be suitable at the temperature and pressure for the cargo to be carried in accordance with recognized standards. Steel is assumed to be the normal material of construction.

6.2 The shipyard is responsible for providing compatibility information to the ship operator and/or master. This must be done in a timely manner before delivery of the ship or on completion of a relevant modification of the material of construction.

LR 6.2(a) The requirement of *Ch 1, 6.1 Materials of construction and welding* only deals with the compatibility of the material of construction with the intended cargoes. Material of construction is to comply with the requirements of the Rules for Materials and any modification of the material of construction is to be submitted for approval.

6.3 Where applicable, the following should be taken into account in selecting the material of construction:

(a) notch ductility at the operating temperature;
(b) corrosive effect of the cargo; and
(c) possibility of hazardous reactions between the cargo and the material of construction.

LR 6.3(a) Except where otherwise required by the provisions of this Code the materials are to comply with the *Rules for the Manufacture, Testing and Certification of Materials, July 2017*.

LR 6.3(b) Materials for cargo piping systems are to comply with the requirements of *Pt 5, Ch 12 Piping Design Requirements* of the Rules for Ships for Class II systems. Materials for open ended and vent piping may be to Class III requirements. *See also Ch 1, 6.1 Materials of construction and welding*.

LR 6.3(c) The grade of steel to be used in hull construction is in general related to the thickness of the material and, stress pattern associated with its location and notch ductility at the minimum operating temperature. Steels with different levels of notch toughness are specified in the Rules for Materials.

LR 6.3(d) The material grade requirements for different hull members are given in *Pt 3, Ch 2, 2 Fracture control* of the Rules for Ships.

LR 6.3(e) Where product purity is particularly important, a material of enhanced corrosion resistance may be necessary, and the shipyard shall advise accordingly, *see* 6.2.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

LR 6.3(f) Hatch packing material is to be resistant to both the liquids and vapours to which it is exposed and is to be efficiently held in place.

LR 6.3(g) When aluminium is used in tank construction, requirements for the material are to comply with the Rules for Materials.

LR 6.3(h) Where stainless steel is required or accepted as an alternative to mild steel then it is to be essentially an austenitic or duplex type and comply with the appropriate requirements of the *Rules for the Manufacture, Testing and Certification of Materials, July 2017*. Alternative, austentic or duplex grades of stainless steel may be accepted provided they comply with National or Proprietary specifications and are suitable for the intended purpose.

LR 6.3(j) The surface finish specification and permissible repair procedures for stainless steel surfaces for cargo tanks are to be agreed between the Owner, the Builder and the steel supplier of the stainless steel plate or clad carbon steel plate on the purchase order, *see also LR IV.1* .

LR 6.3(k) In general, stainless steel tanks are not to be used for the carriage of sea water. Mild steel fittings are not permitted in stainless steel cargo tanks.

LR 6.3(l) The suitability of coatings and compatibility with intended cargoes are the responsibility of the Builder and the Owner. A copy of the coating manufacturer's product resistance list is to be placed on board.

LR 6.3(m) Materials of construction having a melting point below 925°C, e.g. aluminium and its alloys, should not be used for external piping involved in cargo-handling operations on ships intended for the carriage of products with flashpoints not exceeding 60°C (closed cup test) unless specified by the shipyard, *see Ch 1, 6.1 Materials of construction and welding* Short lengths of external pipes connected to cargo tanks may be fitted if they are provided with fire-resistant insulation. These requirements do not apply to cargo hoses.

LR 6.3(n) Where a pre-fabrication primer is used, it is to comply with the requirements of *Pt 3, Ch 2, 3 Corrosion protection* of the Rules for Ships.

LR 6.3(o) Pre-fabrication primers containing zinc are not to be applied to stainless steel. Where zinc primers are applied to other materials which are to be welded, the arrangements are to be such as to preclude zinc contamination of the stainless steel components.

LR 6.3(p) *See Ch 1, 15.11 Acids 15.11.2* concerning the lining of tanks and piping systems.

LR 6.3(q) Where applicable, a sacrificial anode cathodic protection system may be used for the protection of the ballast tanks providing there is no other limitation on the use of the anode material. For details of anode design, attachment and location see *Pt 3, Ch 2, 3 Corrosion protection* of the Rules for Ships.

LR 6.3(r) Where special structural materials and linings have been used, a plan showing the location and grades of material utilised is to be placed on board the ship.

LR 6.3(s) Welding is to be performed using welding procedures that have been qualified by testing in accordance with*Ch 12 Welding Qualifications* of the Rules for Materials.

LR 6.3(t) Welders and welder operators are to possess the necessary skills for the type of materials to be welded and the quality of work to be undertaken. Welders are to be qualified in accordance with the requirements of *Ch 12 Welding Qualifications* of the Rules for Materials.

LR 6.3(u) All construction welding is to be performed in accordance with the requirements of the *Ch 13 Requirements for Welded Construction* of the Rules for Materials.

LR 6.3(v) Inspection of all welded construction is to be in accordance with the requirements specified in *Ch 13 Requirements for Welded Construction*of the Rules for Materials.

LR 6.3(w) In addition, the following non-destructive examination is to be carried out on ships to be assigned the class notation **'Chemical tanker'**:

(a) All crossings of butts and seams of cargo tank bulkhead plating joints welded in assembly areas or on the berth.

(b) Where cargo tank boundary welding is completed in assembly areas or on the berth, a minimum of 10 per cent of the total weld length is to be crack detected.

(c) Where side and bottom longitudinal framing and longitudinal stiffeners terminate at transverse bulkheads, a minimum of 10 per cent of the bulkhead boundary connections is to be crack detected in addition to the requirement given in *Ch 1, 6.1 Materials of construction and welding 6.1..(b)*.

(d) Where longitudinal framing and longitudinal bulkhead stiffeners are continuous through transverse bulkheads, 30 per cent each of the bottom and shipside boundaries and 20 per cent of the longitudinal bulkhead boundaries are to be crack detected in addition to the requirement given in *Ch 1, 6.1 Materials of construction and welding 6.1..(b)*.

(e) Where transverse framing members are continuous through the cargo tank boundary, a minimum of 10 per cent of boundary connections is to be crack detected.

6.4 The shipper of the cargo is responsible for providing compatibility information to the ship operator and/or master. This must be done in a timely manner before transportation of the product. The cargo shall be compatible with all materials of construction such that:

(a) no damage to the integrity of the materials of construction is incurred; and/or

(b) no hazardous, or potentially hazardous reaction is created.

6.5 When a product is submitted to IMO for evaluation, and where compatibility of the product with materials referred to in paragraph 6.1 renders special requirements, the BLG Product Data Reporting form shall provide information on the required materials of construction. These requirements shall be reflected in *chapter 15* and consequentially be referred to in *column o* of *chapter 17*. The reporting form shall also indicate if no special requirements are necessary. The producer of the product is responsible for providing the correct information.

Cargo Temperature Control

7.1 General

7.1.1 When provided, any cargo heating or cooling systems shall be constructed, fitted and tested to the satisfaction of the Administration. Materials used in the construction of temperature-control systems shall be suitable for use with the product intended to be carried.

LR 7.1 General

LR 7.1(a) For the carriage of cargoes for which special temperature control is required, as noted in column 'o' in the table of *Chapter 17*, heating and/or cooling systems complying with the requirements set out hereunder, are to be provided. Where appropriate, notations in the Register Book will be assigned as provided for in *LR III.2 Class Notation (refrigerated installation)*.

LR 7.1(b) When temperature control systems installed for operational reasons, such as those intended for maintaining cargoes other than those listed above, at temperatures suitable for the preservation of quality, or at viscosities which facilitate cargo transfer, comply fully with the requirements, they will also be eligible for the class notations given in *LR III.2 Class Notation (refrigerated installation)*.

LR 7.2 Systems

LR 7.2(a) Temperature control systems include the following:

Active	Pipe coils or ducts for circulating a heating or cooling medium within, or adjacent to, the bulk of the cargo.
or	A heat exchanger through which the cargo and a heating or cooling medium is circulated.
Passive	Thermal insulation of tanks intended to maintain a pre-heated or pre-cooled cargo within a specified range of temperatures for a limited period of time without applied heating or cooling.

LR 7.3 Requirements

***LR 7.3(a)* Capacity**

LR 7.3(a).1 Active heating and cooling systems are to have capacity such that the cargo in the designated tanks can be maintained at the carrying temperature under the following conditions:

	Heating systems	Cooling systems
Seawater temperature	0°C	32°C
Air temperature	5°C	45°C

Limiting tank boundary temperatures to be specified.

NOTE: For the purpose of calculation it is to be assumed that the cargo is loaded at the carrying temperature.

LR 7.3(a).2 If capacity in excess of that required to comply with the foregoing is installed for the purpose of heating or cooling cargoes to temperatures different from that at which they are loaded, the distinguishing mark ‡ will be assigned.

LR 7.3(a).3 Passive systems will be examined in respect of suitability for specified cargoes, conditions and voyages, on submission of relevant details.

LR 7.3(a).4 Where cooling systems incorporate mechanical refrigeration, the installation is to comply with the requirements of *Pt 6, Ch 3 Refrigerated Cargo Installations* of the Rules for Ships, so far as they are applicable. Such an installation is not to be used for any other cooling duty.

LR 7.3(b) **Stand-by plant**

LR 7.3(b).1 Heating and cooling systems are to be duplicated to the following extent:

LR 7.3(b).2 Coil or duct systems are to have not less than two independent circuits per tank. There is to be sufficient capacity for the total required minimum heating or cooling with any one circuit out of action, and the circuits are to be so arranged that the heating or cooling can be evenly distributed throughout the cargo.

LR 7.3(b).3 Deck lines for heating and cooling media need not be duplicated.

LR 7.3(b).4 There are to be two independent sources of heat input. These may be boilers or other devices such as calorifiers or air heaters, each being of sufficient capacity to supply at least the minimum requirement.

LR 7.3(b).5 Heat exchangers (where fitted) are to be duplicated.

LR 7.3(b).6 Circulating pumps for both cargo, and heating or cooling media (where fitted) are to be duplicated. Cargo pumps may be used for cargo circulation if suitable.

LR 7.3(b).7 Refrigeration plant for cargo cooling is to comply with *Pt 6, Ch 3, 2.2 Refrigerants and classes of pipes 2.2.1* of the Rules for Ships, with regard to stand-by capacity.

LR 7.3(b).8 All duplicate machinery and circuits are to be capable of being isolated without inhibiting the operation of the remainder of the system.

7.1.2 Heating or cooling media shall be of a type approved for use with the specific cargo. Consideration shall be given to the surface temperature of heating coils or ducts to avoid dangerous reactions from localized overheating or overcooling of cargo. (See also *Ch 1, 15.13 Cargoes protected by additives 15.13.6*.)

7.1.3 Heating or cooling systems shall be provided with valves to isolate the system for each tank and to allow manual regulation of flow.

LR 7.3(c) *See also Ch 1, 16.6 Cargoes not to be exposed to excessive heat 16.6.2*.

7.1.4 In any heating or cooling system, means shall be provided to ensure that, when in any condition other than empty, a higher pressure can be maintained within the system than the maximum pressure head that could be exerted by the cargo tank contents on the system.

7.1.5 Means shall be provided for measuring the cargo temperature.

(a) The means for measuring the cargo temperature shall be of restricted or closed type, respectively, when a restricted or closed gauging device is required for individual substances, as shown in *column j* in the table of *chapter 17*.

(b) A restricted temperature-measuring device is subject to the definition for a restricted gauging device in *Ch 1, 13.1 Gauging 13.1.1.(b)* (e.g. a portable thermometer lowered inside a gauge tube of the restricted type).

(c) A closed temperature-measuring device is subject to the definition for a closed gauging device in *Ch 1, 13.1 Gauging 13.1.1.(c)* (e.g. a remote-reading thermometer of which the sensor is installed in the tank).

(d) When overheating or overcooling could result in a dangerous condition, an alarm system which monitors the cargo temperature shall be provided. (See also operational requirements in *Ch 1, 16.6 Cargoes not to be exposed to excessive heat*.)

LR 7.4 Cargo temperature measurement

(Applicable to tanks which are designated for the carriage of temperature-controlled cargoes).

LR 7.4(a) In each integral tank, temperature measuring positions are to be so disposed that a reliable mean cargo temperature can be obtained. Where limiting tank boundary temperatures are specified, means for determining these temperatures are also to be provided.

LR 7.4(b) For the carriage of ammonium nitrate solutions (UN 2426) and hydrogen peroxide (UN 2015) there are to be not less than five measuring points per tank, in well separated positions spanning substantially the full depth and horizontal area of the tank, one of which is to be in the vicinity of the volumetric centroid of the tank.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

LR 7.4(c) Similar provision is recommended for all high viscosity and polymerising cargoes.

LR 7.4(d) Where cargoes are carried in integral tanks at temperatures which could influence the properties of the structural steelwork, additional measuring points and alarms may be required.

LR 7.4(e) Independent tanks intended for the carriage of heated or cooled cargoes are to have not less than two measuring points, well separated within the centre 60 per cent of the tank depth.

LR 7.4(f) In tanks of all types, intended for the carriage of heated or cooled cargoes there are to be alternative means of measuring temperatures:

LR 7.4(g) For 'closed' temperature measuring devices, all sensors may be connected to a single indicator/ recorder, but a stand-by indicator/recorder with suitable switching arrangements is to be provided. Alternatively, there may be at least two indicator/ recorders, each permanently connected to approximately half the sensors in each tank.

LR 7.4(h) Tanks which are adapted primarily to 'restricted' temperature measuring devices are to have at least one 'closed' device per tank which can be read under all sea conditions.

7.1.6 When products for which *Ch 1, 15.12 Toxic products Ch 1, 15.12 Toxic products 15.12.1* or *Ch 1, 15.12 Toxic products 15.12.3* are listed in *column o* in the table of *chapter 17* are being heated or cooled, the heating or cooling medium shall operate in a circuit:

(a) which is independent of other ship's services, except for another cargo heating or cooling system, and which does not enter the machinery space; or

(b) which is external to the tank carrying toxic products; or

(c) where the medium is sampled to check for the presence of cargo before it is recirculated to other services of the ship or into the machinery space. The sampling equipment shall be located within the cargo area and be capable of detecting the presence of any toxic cargo being heated or cooled. Where this method is used, the coil return shall be tested not only at the commencement of heating or cooling of a toxic product, but also on the first occasion the coil is used subsequent to having carried an unheated or uncooled toxic cargo.

7.2 Additional requirements

7.2.1 For certain products, additional requirements contained in *chapter 15* are shown in *column o* in the table of *chapter 17*.

Cargo Tank Venting and Gas-Freeing Arrangements

8.1 Application

8.1.1 Unless expressly provided otherwise, this chapter applies to ships constructed on or after 1 January 1994.

8.1.2 Ships constructed before 1 January 1994 shall comply with the requirements of *chapter 8* of this Code which were in force prior to the said date.

8.1.3 For the purpose of this regulation, the term "ship constructed" is as defined in SOLAS *Regulation 1 - Application*.

8.1.4 Ships constructed on or after 1 July 1986 but before 1 January 1994 which fully comply with the requirements of the Code applicable at that time may be regarded as complying with the requirements of SOLAS *Regulation 4 - Probability of ignition* and *Regulation 11 - Structural integrity*.

8.1.5 For ships to which the Code applies, the requirements of this chapter shall apply in lieu of SOLAS regulations II-2/ *Regulation 4 - Probability of ignition*, *Regulation 4 - Probability of ignition* and *3 Additional requirements for tankers .3.3*.

8.1.6 Ships constructed on or after 1 July 1986, but before 1 July 2002 shall comply with the requirements of *Ch 1, 8.3 Types of tank venting systems 8.3.3*.

8.2 Cargo tank venting

8.2.1 All cargo tanks shall be provided with a venting system appropriate to the cargo being carried and these systems shall be independent of the air pipes and venting systems of all other compartments of the ship. Tank venting systems shall be designed so as to minimize the possibility of cargo vapour accumulating about the decks, entering accommodation, service and machinery spaces and control stations and, in the case of flammable vapours, entering or collecting in spaces or areas containing

sources of ignition. Tank venting systems shall be arranged to prevent entrance of water into the cargo tanks and, at the same time, vent outlets shall direct the vapour discharge upwards in the form of unimpeded jets.

8.2.2 The venting systems shall be connected to the top of each cargo tank and as far as practicable the cargo vent lines shall be self-draining back to the cargo tanks under all normal operational conditions of list and trim. Where it is necessary to drain venting systems above the level of any pressure/vacuum valve, capped or plugged drain cocks shall be provided.

8.2.3 Provision shall be made to ensure that the liquid head in any tank does not exceed the design head of the tank. Suitable high-level alarms, overflow control systems or spill valves, together with gauging and tank filling procedures, may be accepted for this purpose. Where the means of limiting cargo tank overpressure includes an automatic closing valve, the valve shall comply with the appropriate provisions of *Ch 1, 15.19 Overflow control*.

LR 8.2(a) The system for guarding against liquid rising to a height which would exceed the design head of the cargo tanks is to be independent of the gauging devices.

LR 8.2(b) Attention is drawn to the need to comply with any more onerous filling height restrictions imposed by the carriage of high relative density cargoes (ie above 1,025).

8.2.4 Tank venting systems shall be designed and operated so as to ensure that neither pressure nor vacuum created in the cargo tanks during loading or unloading exceeds tank design parameters. The main factors to be considered in the sizing of a tank venting system are as follows:

(a) design loading and unloading rate;
(b) gas evolution during loading: this shall be taken account of by multiplying the maximum loading rate by a factor of at least 1.25;
(c) density of the cargo vapour mixture;
(d) pressure loss in vent piping and across valves and fittings; and
(e) pressure/vacuum settings of relief devices.

8.2.5 Tank vent piping connected to cargo tanks of corrosion-resistant material, or to tanks which are lined or coated to handle special cargoes as required by the Code, shall be similarly lined or coated or constructed of corrosion-resistant material.

8.2.6 The master shall be provided with the maximum permissible loading and unloading rates for each tank or group of tanks consistent with the design of the venting systems.

8.3 Types of tank venting systems

8.3.1 An open tank venting system is a system which offers no restriction except for friction losses to the free flow of cargo vapours to and from the cargo tanks during normal operations. An open venting system may consist of individual vents from each tank, or such individual vents may be combined into a common header or headers, with due regard to cargo segregation. In no case shall shutoff valves be fitted either to the individual vents or to the header.

8.3.2 A controlled tank venting system is a system in which pressure- and vacuum-relief valves or pressure/vacuum valves are fitted to each tank to limit the pressure or vacuum in the tank. A controlled venting system may consist of individual vents from each tank or such individual vents on the pressure side only as may be combined into a common header or headers, with due regard to cargo segregation. In no case shall shut-off valves be fitted either above or below pressure- or vacuum-relief valves or pressure/vacuum valves. Provision may be made for bypassing a pressure- or vacuum-relief valve or pressure/vacuum valve under certain operating conditions provided that the requirement of *Ch 1, 8.3 Types of tank venting systems 8.3.6* is maintained and that there is suitable indication to show whether or not the valve is bypassed.

8.3.3 Controlled tank venting systems shall consist of a primary and a secondary means of allowing full flow relief of vapour to prevent over-pressure or under-pressure in the event of failure of one means. Alternatively, the secondary means may consist of pressure sensors fitted in each tank with a monitoring system in the ship's cargo control room or position from which cargo operations are normally carried out. Such monitoring equipment shall also provide an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a tank.

8.3.4 The position of vent outlets of a controlled tank venting system shall be arranged:

(a) at a height of not less than 6 m above the weather deck or above a raised walkway if fitted within 4 m of the raised walkway; and
(b) at a distance of at least 10 m measured horizontally from the nearest air intake or opening to accommodation, service and machinery spaces and ignition sources.

8.3.5 The vent outlet height referred to in *Ch 1, 8.3 Types of tank venting systems 8.3.4* may be reduced to 3 m above the deck or a raised walkway, as applicable, provided that high-velocity venting valves of an approved type, directing the vapour/air mixture upwards in an unimpeded jet with an exit velocity of at least 30 m/s, are fitted.

8.3.6 Controlled tank venting systems fitted to tanks to be used for cargoes having a flashpoint not exceeding 60°C (closed-cup test) shall be provided with devices to prevent the passage of flame into the cargo tanks. The design, testing and locating of the devices shall comply with the requirements of the Administration, which shall contain at least the standards adopted by the Organization.

8.3.7 In designing venting systems and in the selection of devices to prevent the passage of flame for incorporation into the tank venting system, due attention shall be paid to the possibility of the blockage of these systems and fittings by, for example, the freezing of cargo vapour, polymer build-up, atmospheric dust or icing up in adverse weather conditions. In this context it shall be noted that flame arresters and flame screens are more susceptible to blockage. Provisions shall be made such that the system and fittings may be inspected, operationally checked, cleaned or renewed as applicable.

8.3.8 Reference in *Ch 1, 8.3 Types of tank venting systems 8.3.1* and *Ch 1, 8.3 Types of tank venting systems 8.3.2* to the use of shutoff valves in the venting lines shall be interpreted to extend to all other means of stoppage, including spectacle blanks and blank flanges.

8.4 Venting requirements for individual products

8.4.1 Venting requirements for individual products are shown in *column g*, and additional requirements in *column o* in the table of *chapter 17*.

8.5 Cargo-tank purging

8.5.1 When the application of inert gas is required by *Ch 1, 11.1 Application 11.1.1*, before gas-freeing, the cargo tanks shall be purged with inert gas through outlet pipes with cross-sectional area such that an exit velocity of at least 20 m/s can be maintained when any three tanks are being simultaneously supplied with inert gas. The outlets shall extend not less than 2 m above the deck level. Purging shall continue until the concentration of hydrocarbon or other flammable vapours in the cargo tanks has been reduced to less than 2 per cent by volume.

8.6 Cargo-tank gas-freeing

8.6.1 The arrangements for gas-freeing cargo tanks used for cargoes other than those for which open venting is permitted shall be such as to minimize the hazards due to the dispersal of flammable or toxic vapours in the atmosphere and to flammable or toxic vapour mixtures in a cargo tank. Accordingly, gas-freeing operations shall be carried out such that vapour is initially discharged:

(a) through the vent outlets specified in *Ch 1, 8.3 Types of tank venting systems 8.3.4* and *Ch 1, 8.3 Types of tank venting systems 8.3.5*; or

(b) through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 30 m/s maintained during the gas-freeing operation; or

(c) through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 20 m/s which are protected by suitable devices to prevent the passage of flame.

When the flammable vapour concentration at the outlets has been reduced to 30% of the lower flammable limit and, in the case of a toxic product, the vapour concentration does not present a significant health hazard, gas-freeing may thereafter be continued at cargo tank deck level.

8.6.2 The outlets referred to in *Ch 1, 8.6 Cargo-tank gas-freeing 8.6.1.(b)* and *Ch 1, 8.6 Cargo-tank gas-freeing 8.6.1.(c)* may be fixed or portable pipes.

8.6.3 In designing a gas-freeing system in conformity with *Ch 1, 8.6 Cargo-tank gas-freeing 8.6.1*, particularly in order to achieve the required exit velocities of *Ch 1, 8.6 Cargo-tank gas-freeing 8.6.1.(b)* and *Ch 1, 8.6 Cargo-tank gas-freeing 8.6.1.(c)*, due consideration shall be given to the following:

(a) materials of construction of system;

(b) time to gas-free;

(c) flow characteristics of fans to be used;

(d) the pressure losses created by ducting, piping, cargo tank inlets and outlets;

(e) the pressure achievable in the fan driving medium (e.g. water or compressed air); and

(f) the densities of the cargo vapour/air mixtures for the range of cargoes to be carried.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

Environmental Control

9.1 General

9.1.1 Vapour spaces within cargo tanks and, in some cases, spaces surrounding cargo tanks may require to have specially controlled atmospheres.

LR 9.1(a) For the purposes of inerting, Resolutions A.566(14) and *IMO Resolution A.567(14) – Regulation for Inert Gas Systems on Chemical Tankers – (Adopted on 20 November 1985)*, as may be amended, in the IMO publication of 14th Assembly Resolutions, are to be complied with as applicable.

9.1.2 There are four different types of control for cargo tanks, as follows:

(a) *Inerting:* by filling the cargo tank and associated piping systems and, where specified in *chapter 15*, the spaces surrounding the cargo tanks, with a gas or vapour which will not support combustion and which will not react with the cargo, and maintaining that condition.

(b) *Padding:* by filling the cargo tank and associated piping systems with a liquid, gas or vapour which separates the cargo from the air, and maintaining that condition.

(c) *Drying:* by filling the cargo tank and associated piping systems with moisturefree gas or vapour with a dewpoint of -40°C or below at atmospheric pressure, and maintaining that condition.

(d) *Ventilation:* forced or natural.

9.1.3 Where inerting or padding of cargo tanks is required by the Code in column "h" of Chapter 17 of the IBC Code:

(a) An adequate supply of inert gas for use in filling and discharging the cargo tanks shall be carried or shall be manufactured on board unless a shore supply is available. In addition, sufficient inert gas shall be available on the ship to compensate for normal losses during transportation.

(b) The inert gas system on board the ship shall be able to maintain a pressure of at least 0.007 MPa gauge within the containment system at all times. In addition, the inert gas system shall not raise the cargo tank pressure to more than the tank's relief-valve setting.

(c) Where padding is used, similar arrangements for supply of the padding medium shall be made as required for inert gas in *Ch 1, 9.1 General 9.1.3* and *Ch 1, 9.1 General 9.1.3.(b)*.

(d) Means shall be provided for monitoring ullage spaces containing a gas blanket to ensure that the correct atmosphere is being maintained.

(e) Inerting or padding arrangements or both, where used with flammable cargoes, shall be such as to minimize the creation of static electricity during the admission of the inerting medium.

9.1.4 Where drying is used and dry nitrogen is used as the medium, similar arrangements for supply of the drying agent shall be made to those required in *Ch 1, 9.1 General 9.1.3*. Where drying agents are used as the drying medium on all air inlets to the tank, sufficient medium shall be carried for the duration of the voyage, taking into consideration the diurnal temperature range and the expected humidity.

9.2 Environmental control requirements for individual products

9.2.1 The required types of environmental control for certain products are shown in *column h* in the table of *LR 17.1 General*.

Electrical Installations

10.1 General

LR 10.1(a) The requirements of this Chapter are additional to those of *Pt 6, Ch 2 Electrical Engineering* of the Rules for Ships.

LR 10.1(b) In cases where LR is authorised to issue the relevant statutory certificates, and is required to do so, the requirements of this Chapter, including LR's interpretations where relevant and the requirements of *Pt 6, Ch 2 Electrical Engineering* of the Rules for Ships will be applied together with any amendment or interpretation adopted by the appropriate National Authority.

10.1.1 The provisions of this chapter are applicable to ships carrying cargoes which are inherently, or due to their reaction with other substances, flammable or corrosive to the electrical equipment, and shall be applied in conjunction with applicable electrical requirements of *Part D - Electrical installations* of chapter II-1 of SOLAS.

10.1.2.1 Electrical installations shall be such as to minimize the risk of fire and explosion from flammable products[3].

LR 10.1(c) Where electrical equipment is to be of a 'safe type' in order to comply with IEC 60092 : *Electrical installations in ships - Part 502: Tankers - Special features*, such equipment is to be certified for the gases/vapours involved. The construction and type testing is to be in accordance with IEC Publication 60079: , *Electrical Apparatus for Explosive Gas Atmospheres*, or an equivalent National Standard.

10.1.2.2 Where the specific cargo is liable to damage the materials normally used in electrical apparatus, due consideration shall be given to the particular characteristics of the materials chosen for conductors, insulation, metal parts, etc. As far as necessary, these components shall be protected to prevent contact with gases or vapours liable to be encountered.

10.1.3 The Administration shall take appropriate steps to ensure uniformity in the implementation and the application of the provisions of this chapter in respect of electrical installations.

10.1.4 Electrical equipment, cables and wiring shall not be installed in the hazardous locations unless it conforms with the standards not inferior to those acceptable to the Organization[3]. However, for locations not covered by such standards, electrical equipment, cables and wiring which do not conform to the standards may be installed in hazardous locations based on a risk assessment to the satisfaction of the Administration, to ensure that an equivalent level of safety is assured.

LR 10.1(d) Absence of information on temperature class and apparatus group in column *i* in the Table of *Chapter 17* means that data are not currently available, and this should not be confused with the non-flammable (NF) notation describing some substances. For those cargoes where there is absence of information on temperature class and apparatus group in *Chapter 17*, this information is to be submitted where carriage is contemplated.

10.1.5 Where electrical equipment is installed in hazardous locations, as permitted in this chapter, it shall be to the satisfaction of the Administration and certified by the relevant authorities recognized by the Administration for operation in the flammable atmosphere concerned, as indicated in *column i* in the table of *chapter 17*.

10.1.6 For guidance, indication is given if the flashpoint of a substance is in excess of 60°C. In the case of a heated cargo, carriage conditions might need to be established and the requirements for cargoes having a flashpoint not exceeding 60°C applied.

LR 10.1(e) The emergency source of electrical power is also to remain operable under the conditions described in *Ch 1, 2.9 Survival requirements* Survival requirements.

10.2 Bonding

10.2.1 Independent cargo tanks shall be electrically bonded to the hull. All gasketed cargo-pipe joints and hose connections shall be electrically bonded.

10.3 Electrical requirements for individual products

10.3.1 Electrical requirements for individual products are shown in *column i* in the table of *LR 17.1 General*.

LR 10.3(a) For chlorosulphonic acid, hydrochloric acid, nitric acid, oleum, phosphoric acid, sulphuric acid and trimethylacetic acid, the hazardous areas identified in IEC 60092 *Electrical installations in ships - Part 502: Tankers - Special features, 4.5 Tankers carrying cargoes (for example acids) reacting with other products/materials to evolve flammable gases* are applicable. The relevant gas group and temperature class are IIC T1.

LR 10.3(b) For sulphur liquid, the hazardous areas identified in IEC 60092 *Electrical installations in ships - Part 502: Tankers - Special features, 4.3 Tankers carrying flammable liquids having a flashpoint exceeding 60 ºC*, are applicable. The relevant gas group and temperature class are IIB T3.

[3] Reference is made to the recommendations published by the International Electrotechnical Commission and in particular to Publication 92-502, *Electrical Installations in Ships* - Part 502: Special features - Tankers.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

Fire Protection and Fire Extinction

11.1 Application

11.1.1 The requirements for tankers in SOLAS *Chapter II-2 - Construction - Fire protection, fire detection and fire extinction* shall apply to ships covered by the Code, irrespective of tonnage, including ships of less than 500 tons gross tonnage, except that:

(a) *Regulation 10 - Fire fighting* and *Regulation 10 - Fire fighting* shall not apply;

(b) *Regulation 4 - Probability of ignition* (i.e. the requirements for location of the main cargo control station) need not apply;

(c) *Regulation 10 - Fire fighting* shall apply as they would apply to cargo ships of 2,000 tons gross tonnage and over;

(d) regulation *Regulation 10 - Fire fighting* shall apply to ships of 2,000 gross tonnage and over;

(e) the provisions of 11.3 shall apply in lieu of *8 Cargo tank protection*;

(f) the provisions of 11.2 shall apply in lieu of *9 Protection of cargo pump rooms in tankers*;

(g) *5.10 Protection of cargo pump-rooms* shall apply to ships of 500 gross tonnage and over, replacing “hydrocarbon gases” by “flammable vapours” in the regulation; and

(h) *3.4 Emergency escape breathing devices* and *4.3 Emergency escape breathing devices* shall apply to ships of 500 gross tonnage and over.

11.1.2 Notwithstanding the provisions of *Ch 1, 11.1 Application 11.1.1*, ships engaged solely in the carriage of products which are non-flammable (entry NF in *column i* of the table of minimum requirements) need not comply with requirements for tankers specified in SOLAS *Chapter II-2 - Construction - Fire protection, fire detection and fire extinction*, provided that they comply with the requirements for cargo ships of that chapter, except that *Regulation 10 - Fire fighting* need not apply to such ships and *Regulation 11 - Structural integrity*, hereunder, need not apply.

11.1.3 For ships engaged solely in the carriage of products with a flashpoint of 60°C and above (entry "Yes" in *column i* of the table of minimum requirements), the requirements of SOLAS *Chapter II-2 - Construction - Fire protection, fire detection and fire extinction* may apply as specified in *Regulation 1 - Application1* in lieu of the provisions of this chapter.

11.1.4 In lieu of the provisions of SOLAS *6 Application of requirements for tankers*, the requirements of *5.10 Protection of cargo pump-rooms* shall apply and a system for continuous monitoring of the concentration of flammable vapours shall be fitted on ships of 500 gross tonnage and over which were constructed before 1 January 2009 by the date of the first scheduled dry-docking after 1 January 2009, but not later than 1 January 2012. Sampling points or detector heads should be located in suitable positions in order that potentially dangerous leakages are readily detected. When the flammable vapour concentration reaches a pre-set level which shall not be higher than 10% of the lower flammable limit, a continuous audible and visual alarm signal shall be automatically effected in the pump-room and cargo control room to alert personnel to the potential hazard. However, existing monitoring systems already fitted having a pre-set level not greater than 30% of the lower flammable limit may be accepted. Notwithstanding the above provisions, the Administration may exempt ships not engaged on international voyages from those requirements.

LR 11.1(a) These requirements for fire protection and fire-extinction are not part of the Classification Rules. However, compliance with the *International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk* (*IBC Code - International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in BulkAmended by Resolution MEPC.225(64)*), being a requirement of the 1983 Amendments to the *International Convention for the Safety of Life at Sea 1974*, is a prerequisite of Classification. *See Pt 1, Ch 2, 1.1 General 1.1.9*. This is to be demonstrated by possession of an International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk issued by a National Authority or by LR when so authorised. When issued by LR, the requirements of this Chapter will be applied together with any interpretation of the requirements specified by the appropriate National Authority. When issued by the National Authority, the requirements of this Chapter will be the sole prerogative of the National Authority and will not be applied directly by LR for Classification purposes. *See also LR II.1 General* and *LR II.2 Ship survival capability, fire protection and fire-extinction and operational requirements*.

LR 11.1(b) References in *Ch 1, 11.2 Cargo pump-rooms* and 11.2 to Chapter II- 2 of the 1983 SOLAS amendments should be further referred to *Chapter II-2 - Construction - Fire protection, fire detection and fire extinction* of the consolidated text of the 1974 SOLAS Convention.

11.2 Cargo pump-rooms

11.2.1 The cargo pump-room of any ship shall be provided with a fixed carbon dioxide fire-extinguishing system as specified in SOLAS *Regulation 10 - Fire fighting*. A notice shall be exhibited at the controls stating that the system is only to be used for fire-extinguishing and not for inerting purposes, due to the electrostatic ignition hazard. The alarms referred to in SOLAS *Regulation 10 - Fire fighting* shall be safe for use in a flammable cargo vapour/air mixture. For the purpose of this requirement, an extinguishing system shall be provided which would be suitable for machinery spaces. However, the amount of gas carried shall be sufficient to provide a quantity of free gas equal to 45% of the gross volume of the cargo pump-room in all cases.

11.2.2 Cargo pump-rooms of ships which are dedicated to the carriage of a restricted number of cargoes shall be protected by an appropriate fire-extinguishing system approved by the Administration.

11.2.3 If cargoes are to be carried which are not suited to extinguishment by carbon dioxide or equivalent media, the cargo pump-room shall be protected by a fire extinguishing system consisting of either a fixed pressure water spray or high expansion foam system. The International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall reflect this conditional requirement.

11.3 Cargo area

11.3.1 Every ship shall be provided with a fixed deck foam system in accordance with the requirements of *Ch 1, 11.3 Cargo area 11.3.2* to *Ch 1, 11.3 Cargo area 11.3.12*.

11.3.2 Only one type of foam concentrate shall be supplied, and it shall be effective for the maximum possible number of cargoes intended to be carried. For other cargoes for which foam is not effective or is incompatible, additional arrangements to the satisfaction of the Administration shall be provided. Regular protein foam shall not be used.

11.3.3 The arrangements for providing foam shall be capable of delivering foam to the entire cargo tanks deck area as well as into any cargo tank, the deck of which is assumed to be ruptured.

11.3.4 The deck foam system shall be capable of simple and rapid operation. The main control station for the system shall be suitably located outside of the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fires in the areas protected.

11.3.5 The rate of supply of foam solution shall be not less than the greatest of the following:

(a) 2 *l*/min per square metre of the cargo tanks deck area, where cargo tanks deck area means the maximum breadth of the ship times the total longitudinal extent of the cargo tank spaces;
(b) 20 *l*/min per square metre of the horizontal sectional area of the single tank having the largest such area;
(c) 10 *l*/min per square metre of the area protected by the largest monitor, such area being entirely forward of the monitor, but not less than 1,250 *l*/min. For ships less than 4,000 tonnes deadweight, the minimum capacity of the monitor shall be to the satisfaction of the Administration.

11.3.6 Sufficient foam concentrate shall be supplied to ensure at least 30 min of foam generation when using the highest of the solution rates stipulated in *Ch 1, 11.3 Cargo area 11.3.5*, *Ch 1, 11.3 Cargo area 11.3.5.(b)* and *Ch 1, 11.3 Cargo area 11.3.5.(c)*.

11.3.7 Foam from the fixed foam system shall be supplied by means of monitors and foam applicators. At least 50% of the foam rate required in *Ch 1, 11.3 Cargo area 11.3.5* or *Ch 1, 11.3 Cargo area 11.3.5.(b)* shall be delivered from each monitor. The capacity of any monitor shall be at least 10 *l*/min of foam solution per square metre of deck area protected by that monitor, such area being entirely forward of the monitor. Such capacity shall be not less than 1,250 *l*/min. For ships less than 4,000 tonnes deadweight, the minimum capacity of the monitor shall be to the satisfaction of the Administration.

11.3.8 The distance from the monitor to the farthest extremity of the protected area forward of that monitor shall be not more than 75% of the monitor throw in still air conditions.

11.3.9 A monitor and hose connection for a foam applicator shall be situated both port and starboard at the poop front or accommodation spaces facing the cargo area.

11.3.10 Applicators shall be provided for flexibility of action during fire- fighting operations and to cover areas screened from the monitors. The capacity of any applicator shall be not less than 400 *l*/min and the applicator throw in still air conditions shall be not less than 15 m. The number of foam applicators provided shall be not less than four. The number and disposition of foam main outlets shall be such that foam from at least two applicators can be directed to any part of the cargo tanks deck area.

11.3.11 Valves shall be provided in the foam main, and in the fire main where this is an integral part of the deck foam system, immediately forward of any monitor position to isolate damaged sections of those mains.

11.3.12 Operation of a deck foam system at its required output shall permit the simultaneous use of the minimum required number of jets of water at the required pressure from the fire main.

11.3.13 Ships which are dedicated to the carriage of a restricted number of cargoes shall be protected by alternative provisions to the satisfaction of the Administration when they are just as effective for the products concerned as the deck foam system required for the generality of flammable cargoes.

11.3.14 Suitable portable fire-extinguishing equipment for the products to be carried shall be provided and kept in good operating order.

11.3.15 Where flammable cargoes are to be carried, all sources of ignition shall be excluded from hazardous locations unless such sources conform with *Ch 1, 10.1 General*.

11.3.16 Ships fitted with bow or stern loading and unloading arrangements shall be provided with one additional foam monitor meeting the requirements of *Ch 1, 11.3 Cargo area 11.3.7* and one additional applicator meeting the requirements of *Ch 1, 11.3 Cargo area 11.3.10*. The additional monitor shall be located to protect the bow or stern loading and unloading arrangements. The area of the cargo line forward or aft of the cargo area shall be protected by the above-mentioned applicator.

11.4 Special requirements

11.4.1 All fire-extinguishing media determined to be effective for each product are listed in *column I* in the table of *chapter 17*.

Mechanical Ventilation in the Cargo Area

Scope

For ships to which the Code applies, the requirements of this chapter replace the requirements of SOLAS *Regulation 4 - Probability of ignition*.

However, for products addressed under *Ch 1, 11.1 Application 11.1.2*and *Ch 1, 11.1 Application 11.1.3*, except acids and products for which *Ch 1, 15.17 Increased ventilation requirements* applies, SOLAS *Regulation 4 - Probability of ignition* may apply in lieu of the provisions of this chapter.

12.1 Spaces normally entered during cargo-handling operations

12.1.1 Cargo pump-rooms and other enclosed spaces which contain cargo-handling equipment and similar spaces in which work is performed on the cargo shall be fitted with mechanical ventilation systems, capable of being controlled from outside such spaces.

12.1.2 Provision shall be made to ventilate such spaces prior to entering the compartment and operating the equipment and a warning notice requiring the use of such ventilation shall be placed outside the compartment.

12.1.3 Mechanical ventilation inlets and outlets shall be arranged to ensure sufficient air movement through the space to avoid the accumulation of toxic or flammable vapours or both (taking into account their vapour densities) and to ensure sufficient oxygen to provide a safe working environment, but in no case shall the ventilation system have a capacity of less than 30 changes of air per hour, based upon the total volume of the space. For certain products, increased ventilation rates for cargo pump-rooms are prescribed in *Ch 1, 15.17 Increased ventilation requirements*.

12.1.4 Ventilation systems shall be permanent and shall normally be of the extraction type. Extraction from above and below the floor plates shall be possible. In rooms housing motors driving cargo pumps, the ventilation shall be of the positive-pressure type.

12.1.5 Ventilation exhaust ducts from spaces within the cargo area shall discharge upwards in locations at least 10 m in the horizontal direction from ventilation intakes and openings to accommodation, service and machinery spaces and control stations and other spaces outside the cargo area.

12.1.6 Ventilation intakes shall be so arranged as to minimize the possibility of recycling hazardous vapours from any ventilation discharge opening.

12.1.7 Ventilation ducts shall not be led through accommodation, service and machinery spaces or other similar spaces.

12.1.8 Electric motors driving fans shall be placed outside the ventilation ducts if the carriage of flammable products is intended. Ventilation fans and fan ducts, in way of fans only, for hazardous locations referred to in *chapter 10* shall be of non-sparking construction, defined as:

(a) impellers or housing of non-metallic construction, due regard being paid to the elimination of static electricity;
(b) impellers and housing of non-ferrous materials;
(c) impellers and housing of austenitic stainless steel; and
(d) ferrous impellers and housing with not less than 13 mm design tip clearance.

Any combination of an aluminium or a magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and shall not be used in these places.

12.1.9 Sufficient spare parts shall be carried for each type of fan on board required by this chapter.

12.1.10 Protection screens of not more than 13 mm square mesh shall be fitted in outside openings of ventilation ducts.

12.2 Pump-rooms and other enclosed spaces normally entered

12.2.1 Pump-rooms and other enclosed spaces normally entered which are not covered by *Ch 1, 12.1 Spaces normally entered during cargo-handling operations 12.1.1* shall be fitted with mechanical ventilation systems, capable of being controlled from outside such spaces and complying with the requirements of *Ch 1, 12.1 Spaces normally entered during cargo-handling operations 12.1.3*, except that the capacity shall not be less than 20 changes of air per hour, based upon the total volume of the space. Provision shall be made to ventilate such spaces prior to personnel entering.

12.3 Spaces not normally entered

12.3.1 Double bottoms, cofferdams, duct keels, pipe tunnels, hold spaces and other spaces where cargo may accumulate shall be capable of being ventilated to ensure a safe environment when entry into the spaces is necessary. Where a permanent ventilation system is not provided for such spaces, approved means of portable mechanical ventilation shall be provided. Where necessary, owing to the arrangement of spaces, for instance hold spaces, essential ducting for ventilation shall be permanently installed. For permanent installations the capacity of eight air changes per hour shall be provided and for portable systems the capacity of 16 air changes per hour. Fans or blowers shall be clear of personnel access openings, and shall comply with *Ch 1, 12.1 Spaces normally entered during cargo-handling operations 12.1.8*.

LR 12.3(a) Particulars of the type and number of portable fans, their arrangement and means of attachment are to be submitted for consideration in relation to the internal and external arrangement of the space concerned.

LR 12.3(b) Increased ventilation will be required for spaces which contain gas-freeing systems, unless these systems are totally enclosed.

LR 12.3(c) Ventilation systems are to be capable of use prior to entry and during occupation.

Instrumentation

13.1 Gauging

13.1.1 Cargo tanks shall be fitted with one of the following types of gauging devices:

(a) *Open device:* which makes use of an opening in the tanks and may expose the gauger to the cargo or its vapour. An example of this is the ullage opening.
(b) *Restricted device:* which penetrates the tank and which, when in use, permits a small quantity of cargo vapour or liquid to be exposed to the atmosphere. When not in use, the device is completely closed. The design shall ensure that no dangerous escape of tank contents (liquid or spray) can take place in opening the device.
(c) *Closed device:* which penetrates the tank, but which is part of a closed system and keeps tank contents from being released. Examples are the float-type systems, electronic probe, magnetic probe and protected sight-glass. Alternatively, an *indirect device* which does not penetrate the tank shell and which is independent of the tank may be used. Examples are weighing of cargo, pipe flow meter.

13.1.2 Gauging devices shall be independent of the equipment required under *Ch 1, 15.19 Overflow control*.

13.1.3 Open gauging and restricted gauging shall be allowed only where:

(a) open venting is allowed by the Code; or

(b) means are provided for relieving tank pressure before the gauge is operated.

13.1.4 Types of gauging for individual products are shown in *column j* in the table of *chapter 17*.

13.2 Vapour detection

13.2.1 Ships carrying toxic or flammable products or both shall be equipped with at least two instruments designed and calibrated for testing for the specific vapours in question. If such instruments are not capable of testing for both toxic concentrations and flammable concentrations, then two separate sets of instruments shall be provided.

13.2.2 Vapour-detection instruments may be portable or fixed. If a fixed system is installed, at least one portable instrument shall be provided.

13.2.3 When toxic-vapour-detection equipment is not available for some products which require such detection, as indicated in *column k* in the table of *chapter 17*, the Administration may exempt the ship from the requirement, provided an appropriate entry is made on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk. When granting such an exemption, the Administration shall recognize the necessity for additional breathing-air supply and an entry shall be made on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk drawing attention to the provisions of *Ch 1, 14.2 Safety equipment 14.2.4* and *Ch 1, 16.4 Opening of and entry into cargo tanks 16.4.2.(b)*.

LR 13.2(a) Where LR is not authorised to issue an International Certificate of Fitness, the necessity for additional breathing air supply will be specially considered.

13.2.4 Vapour-detection requirements for individual products are shown in *column k* in the table of *chapter 17*.

Personnel Protection

14.1 Protective equipment

14.1.1 For the protection of crew members who are engaged in loading and discharging operations, the ship shall have on board suitable protective equipment consisting of large aprons, special gloves with long sleeves, suitable footwear, coveralls of chemical-resistant material, and tight-fitting goggles or face shields or both. The protective clothing and equipment shall cover all skin so that no part of the body is unprotected.

14.1.2 Work clothes and protective equipment shall be kept in easily accessible places and in special lockers. Such equipment shall not be kept within accommodation spaces, with the exception of new, unused equipment and equipment which has not been used since undergoing a thorough cleaning process. The Administration may, however, approve storage rooms for such equipment within accommodation spaces if adequately segregated from living spaces such as cabins, passageways, dining rooms, bathrooms, etc.

14.1.3 Protective equipment shall be used in any operation, which may entail danger to personnel.

14.2 Safety equipment

14.2.1 Ships carrying cargoes for which *Ch 1, 15.12 Toxic products Ch 1, 15.12 Toxic products 15.12.1* or *Ch 1, 15.12 Toxic products 15.12.3* is listed in *column o* in the table of *chapter 17* shall have on board sufficient but not less than three complete sets of safety equipment, each permitting personnel to enter a gas-filled compartment and perform work there for at least 20 min. Such equipment shall be in addition to that required by SOLAS *Regulation 10 - Fire fighting*.

14.2.2 One complete set of safety equipment shall consist of:

(a) one self-contained air-breathing apparatus (not using stored oxygen);

(b) protective clothing, boots, gloves and tight-fitting goggles;

(c) fireproof lifeline with belt resistant to the cargoes carried; and

(d) explosion-proof lamp.

14.2.3 For the safety equipment required in *Ch 1, 14.2 Safety equipment 14.2.1*, all ships shall carry either:

(a) one set of fully charged spare air bottles for each breathing apparatus;

(b) a special air compressor suitable for the supply of high-pressure air of the required purity;

(c) a charging manifold capable of dealing with sufficient spare air bottles for the breathing apparatus; or

(d) fully charged spare air bottles with a total free air capacity of at least 6,000 *l* for each breathing apparatus on board in excess of the requirements of SOLAS *Regulation 10 - Fire fighting*.

14.2.4 A cargo pump-room on ships carrying cargoes which are subject to the requirements of *Ch 1, 15.18 Special cargo pump-room requirements* or cargoes for which in *column k* in the table of *chapter 17* toxic-vapour-detection equipment is required but is not available shall have either:

(a) a low-pressure line system with hose connections suitable for use with the breathing apparatus required by *Ch 1, 14.2 Safety equipment 14.2.1*. This system shall provide sufficient high-pressure air capacity to supply, through pressure-reduction devices, enough low-pressure air to enable two men to work in a gas-dangerous space for at least 1 h without using the air bottles of the breathing apparatus. Means shall be provided for recharging the fixed air bottles and the breathing apparatus air bottles from a special air compressor suitable for the supply of high-pressure air of the required purity; or

(b) an equivalent quantity of spare bottled air in lieu of the low-pressure air line.

14.2.5 At least one set of safety equipment as required by *Ch 1, 14.2 Safety equipment 14.2.2* shall be kept in a suitable clearly marked locker in a readily accessible place near the cargo pump-room. The other sets of safety equipment shall also be kept in suitable, clearly marked, easily accessible places.

14.2.6 The breathing apparatus shall be inspected at least once a month by a responsible officer, and the inspection recorded in the ship's log-book. The equipment shall be inspected and tested by an expert at least once a year.

14.3 Emergency equipment

14.3.1 Ships carrying cargoes, for which "Yes" is indicated in *column n* of *chapter 17*, shall be provided with suitable respiratory and eye protection sufficient for every person on board for emergency escape purposes, subject to the following:

(a) filter-type respiratory protection is unacceptable;

(b) self-contained breathing apparatus shall have at least a duration of service of 15 min;

(c) emergency escape respiratory protection shall not be used for fire-fighting or cargo-handling purposes and shall be marked to that effect.

14.3.2 The ship shall have on board medical first-aid equipment, including oxygen resuscitation equipment and antidotes for cargoes to be carried, based on the guidelines developed by the Organization[4].

14.3.3 A stretcher which is suitable for hoisting an injured person up from spaces such as the cargo pump-room shall be placed in a readily accessible location.

14.3.4 Suitably marked decontamination showers and an eyewash shall be available on deck in convenient locations. The showers and eyewash shall be operable in all ambient conditions.

Special Requirements

15.1 General

15.1.1 The provisions of this chapter are applicable where specific reference is made in *column o* in the table of *chapter 17*. These requirements are additional to the general requirements of the Code.

LR 15.1(a) For cargoes dealt with in this Chapter, the hazards are such that the integrity of the containment system and operational safety procedures are of paramount importance. Attention is drawn to possible National Authority and Port Administration requirements for dealing with emergencies involving the cargo concerned.

15.2 Ammonium nitrate solution, (93% or less)

15.2.1 The ammonium nitrate solution shall contain at least 7% by weight of water. The acidity (pH) of the cargo when diluted with ten parts of water to one part of cargo by weight shall be between 5.0 and 7.0. The solution shall not contain more than 10 ppm chloride ions, 10 ppm ferric ions and shall be free of other contaminants.

[4] Reference is made to the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), which provides advice on the treatment of casualties in accordance with the symptoms exhibited as well as equipment and antidotes that may be appropriate for treating the casualty.

LR 15.2(a) The liquid is to be carried in independent, externally insulated tanks which are so supported and keyed as to permit free expansion in all directions and eliminate heat bridges which may transmit thermal stresses to the hull. The tanks are to be constructed of stainless steel taking into account the dynamic loading which will be experienced by the tanks, supports and keys in service. Calculations are to be submitted.

15.2.2 Tanks and equipment for ammonium nitrate solution shall be independent of tanks and equipment containing other cargoes or combustible products. Equipment which may, in service or when defective, release combustible products into the cargo (e.g. lubricants), shall not be used. Tanks shall not be used for seawater ballast.

LR 15.2(b) The hull arrangements may require to incorporate two longitudinal bulkheads for strength reasons in view of the relative density of ammonium nitrate solutions.

15.2.3 Except where expressly approved by the Administration, ammonium nitrate solutions shall not be transported in tanks which have previously contained other cargoes unless tanks and associated equipment have been cleaned to the satisfaction of the Administration.

15.2.4 The temperature of the heat-exchanging medium in the tank heating system shall not exceed 160°C. The heating system shall be provided with a control system to keep the cargo at a bulk mean temperature of 140°C. High-temperature alarms at 145°C and 150°C and a low-temperature alarm at 125°C shall be provided. Where the temperature of the heat-exchanging medium exceeds 160°C, an alarm shall also be given. Temperature alarms and controls shall be located on the navigating bridge.

15.2.5 If the bulk mean cargo temperature reaches 145°C, a cargo sample shall be diluted with ten parts of distilled or demineralized water to one part of cargo by weight and the pH shall be determined by means of a narrow-range indicator paper or stick. Acidity measurements shall then be taken every 24 hours. If the pH is found to be below 4.2, ammonia gas shall be injected into the cargo until the pH of 5.0 is reached.

15.2.6 A fixed installation shall be provided to inject ammonia gas into the cargo. Controls for this system shall be located on the navigation bridge. For this purpose, 300 kg of ammonia per 1,000 tonnes of ammonium nitrate solution shall be available on board.

15.2.7 Cargo pumps shall be of the centrifugal deepwell type or of the centrifugal type with water-flushed seals.

15.2.8 Vent piping shall be fitted with approved weatherhoods to prevent clogging. Such weatherhoods shall be accessible for inspection and cleaning.

15.2.9 Hot work on tanks, piping and equipment which have been in contact with ammonium nitrate solution shall only be done after all traces of ammonium nitrate have been removed, inside as well as outside.

15.3 Carbon disulphide

Carbon disulphide may be carried either under a water pad or under a suitable inert gas pad as specified in the following paragraphs.

Carriage under water pad

15.3.1 Provision shall be made to maintain a water pad in the cargo tank during loading, unloading and transit. In addition, an inert-gas pad shall be maintained in the ullage space during transit.

15.3.2 All openings shall be in the top of the tank, above the deck.

15.3.3 Loading lines shall terminate near the bottom of the tank.

15.3.4 A standard ullage opening shall be provided for emergency sounding.

15.3.5 Cargo piping and vent lines shall be independent of piping and vent lines used for other cargo.

15.3.6 Pumps may be used for discharging cargo, provided they are of the deepwell or hydraulically driven submersible types. The means of driving a deepwell pump shall not present a source of ignition for carbon disulphide and shall not employ equipment that may exceed a temperature of 80°C.

15.3.7 If a cargo discharge pump is used, it shall be inserted through a cylindrical well extending from the tank top to a point near the tank bottom. A water pad shall be formed in this well before attempting pump removal unless the tank has been certified as gas-free.

15.3.8 Water or inert-gas displacement may be used for discharging cargo, provided the cargo system is designed for the expected pressure and temperature.

15.3.9 Safety relief valves shall be of stainless steel construction.

15.3.10 Because of its low ignition temperature and close clearances required to arrest its flame propagation, only intrinsically safe systems and circuits are permitted in the hazardous locations.

Carriage under suitable inert gas pad

15.3.11 Carbon disulphide shall be carried in independent tanks with a design pressure of not less than 0.06 MPa gauge.

15.3.12 All openings shall be located on the top of the tank, above the deck.

15.3.13 Gaskets used in the containment system shall be of a material which does not react with, or dissolve in, carbon disulphide.

15.3.14 Threaded joints shall not be permitted in the cargo containment system, including the vapour lines.

15.3.15 Prior to loading, the tank(s) shall be inerted with suitable inert gas until the oxygen level is 2% by volume or lower. Means shall be provided to automatically maintain a positive pressure in the tank using suitable inert gas during loading, transport and discharge. The system shall be able to maintain this positive pressure between 0.01 and 0.02 MPa, and shall be remotely monitored and fitted with over/underpressure alarms.

15.3.16 Hold spaces surrounding an independent tank carrying carbon disulphide shall be inerted by a suitable inert gas until the oxygen level is 2% or less. Means shall be provided to monitor and maintain this condition throughout the voyage. Means shall also be provided to sample these spaces for carbon disulphide vapour.

15.3.17 Carbon disulphide shall be loaded, transported and discharged in such a manner that venting to the atmosphere does not occur. If carbon disulphide vapour is returned to shore during loading or to the ship during discharge, the vapour return system shall be independent of all other containment systems.

15.3.18 Carbon disulphide shall be discharged only by submerged deepwell pumps or by a suitable inert gas displacement. The submerged deepwell pumps shall be operated in a way that prevents heat build-up in the pump. The pump shall also be equipped with a temperature sensor in the pump housing with remote readout and alarm in the cargo control room. The alarm shall be set at 80°C. The pump shall also be fitted with an automatic shutdown device to be activated if the tank pressure falls below atmospheric pressure during the discharge.

15.3.19 Air shall not be allowed to enter the cargo tank, cargo pump or lines while carbon disulphide is contained in the system.

15.3.20 No other cargo handling, tank cleaning or deballasting shall take place concurrent with loading or discharge of carbon disulphide.

15.3.21 A water spray system of sufficient capacity shall be provided to blanket effectively the area surrounding the loading manifold, the exposed deck piping associated with product handling and the tank domes. The arrangement of piping and nozzles shall be such as to give an uniform distribution rate of 10 l/m^2/min. Remote manual operation shall be arranged such that remote starting of pumps supplying the water-spray system and remote operation of any normally closed valves in the system can be carried out from a suitable location outside the cargo area adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected. The water-spray system shall be capable of both local and remote manual operation, and the arrangement shall ensure that any spilled cargo is washed away. Additionally, a water hose with pressure to the nozzle when atmospheric temperature permits, shall be connected ready for immediate use during loading and unloading operations.

15.3.22 No cargo tanks shall be more than 98% liquid-full at the reference temperature (R).

15.3.23 The maximum volume (V_L) of cargo to be loaded in a tank shall be:

$$V_L = 0.98V\frac{\rho_R}{\rho_L}$$

where:

V = volume of the tank

ρ_R = density of cargo at the reference temperature (R)

ρ_L = density of cargo at the loading temperature

R = reference temperature

15.3.24 The maximum allowable tank filling limits for each cargo tank shall be indicated for each loading temperature which may be applied, and for the applicable maximum reference temperature, on a list approved by the Administration. A copy of the list shall be permanently kept on board by the master.

15.3.25 Zones on open deck, or semi-enclosed spaces on open deck within three metres of a tank outlet, gas or vapour outlet, cargo pipe flange or cargo valve of a tank certified to carry carbon disulphide, shall comply with the electrical equipment requirements specified for carbon disulphide in *column i*, *chapter 17*. Also, within the specified zone, no other heat sources, like steam piping with surface temperatures in excess of 80°C shall be allowed.

15.3.26 Means shall be provided to ullage and sample the cargo without opening the tank or disturbing the positive suitable inert gas blanket.

15.3.27 The product shall be transported only in accordance with a cargo handling plan that has been approved by the Administration. Cargo handling plans shall show the entire cargo piping system. A copy of the approved cargo handling plan shall be available on board. The International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall be endorsed to include reference to the approved cargo handling plan.

15.4 Diethyl ether

LR 15.4(a) These requirements also apply to vinyl ethyl ether.

15.4.1 Unless inerted, natural ventilation shall be provided for the voids around the cargo tanks while the vessel is under way. If a mechanical ventilation system is installed, all blowers shall be of non-sparking construction. Mechanical ventilation equipment shall not be located in the void spaces surrounding the cargo tanks.

15.4.2 Pressure-relief-valve settings shall not be less than 0.02 MPa gauge for gravity tanks.

15.4.3 Inert-gas displacement may be used for discharging cargo from pressure tanks provided the cargo system is designed for the expected pressure.

15.4.4 In view of the fire hazard, provision shall be made to avoid any ignition source or heat generation or both in the cargo area.

15.4.5 Pumps may be used for discharging cargo, provided that they are of a type designed to avoid liquid pressure against the shaft gland or are of a hydraulically operated submerged type and are suitable for use with the cargo.

15.4.6 Provision shall be made to maintain the inert-gas pad in the cargo tank during loading, unloading and transit.

15.5 Hydrogen peroxide solutions

15.5.1 *Hydrogen peroxide solutions over 60% but not over 70% by mass*

15.5.1.1 Hydrogen peroxide solutions over 60% but not over 70% by mass shall be carried in dedicated ships only and no other cargoes shall be carried.

LR 15.5(a) The cargo is to be carried in tanks which are separate from the main hull structure, and which are free of internal supporting members and major structural irregularities.

LR 15.5(b) All openings are to be in the top of the tank and extended above the deck.

LR 15.5(c) For approval purposes, consideration will be given to the need for suitable tests to be undertaken in order to simulate the intended transportation conditions and duration of voyage.

LR 15.5(d) Proposals which involve partial filling of cargo tanks will receive individual consideration.

15.5.1.2 Cargo tanks and associated equipment shall be either pure aluminium (99.5%) or solid stainless steel (304L, 316, 316L or 316Ti), and passivated in accordance with approved procedures. Aluminium shall not be used for piping on deck. All nonmetallic materials of construction for the containment system shall neither be attacked by hydrogen peroxide nor contribute to its decomposition.

LR 15.5(e) Full details of the passivation procedures are to be submitted.

15.5.1.3 Pump-rooms shall not be used for cargo-transfer operations.

15.5.1.4 Cargo tanks shall be separated by cofferdams from fuel oil tanks or any other space containing flammable or combustible materials.

15.5.1.5 Tanks intended for the carriage of hydrogen peroxide shall not be used for seawater ballast.

15.5.1.6 Temperature sensors shall be installed at the top and bottom of the tank. Remote temperature readouts and continuous monitoring shall be located on the navigating bridge. If the temperature in the tanks rises above 35°C, visible and audible alarms shall be activated on the navigating bridge.

LR 15.5(f) Leakages are to be dealt with to LR's satisfaction prior to loading a subsequent hydrogen peroxide cargo.

15.5.1.7 Fixed oxygen monitors (or gas-sampling lines) shall be provided in void spaces adjacent to tanks to detect leakage of the cargo into these spaces. Remote readouts, continuous monitoring (if gas-sampling lines are used, intermittent sampling is

satisfactory) and visible and audible alarms similar to those for the temperature sensors shall also be located on the navigating bridge. The visible and audible alarms shall be activated if the oxygen concentration in these void spaces exceeds 30% by volume. Two portable oxygen monitors shall also be available as back-up systems.

LR 15.5(g) Since hydrogen peroxide is not a heated cargo, heating systems should not, in general, be arranged within cargo tanks. Where heating systems are fitted, these are also to be provided with leakage detection arrangements.

15.5.1.8 As a safeguard against uncontrolled decomposition, a cargo-jettisoning system shall be installed to discharge the cargo overboard. The cargo shall be jettisoned if the temperature rise of the cargo exceeds a rate of 2°C per hour over a 5-hour period or when the temperature in the tank exceeds 40°C.

15.5.1.9 Cargo tank venting systems shall have pressure/vacuum-relief valves for normal controlled venting, and rupture discs or a similar device for emergency venting, should tank pressure rise rapidly as a result of uncontrolled decomposition. Rupture discs shall be sized on the basis of tank design pressure, tank size and anticipated decomposition rate.

LR 15.5(h) Rupture disc calculations are to be submitted for approval.

LR 15.5(j) The rupture discs are to be protected against the weather and the adopted arrangements are not to impede dispersal of the vapour.

15.5.1.10 A fixed water-spray system shall be provided for diluting and washing away any concentrated hydrogen peroxide solution spilled on deck. The areas covered by the water-spray shall include the manifold/hose connections and the tank tops of those tanks designated for carrying hydrogen peroxide solutions. The minimum application rate shall satisfy the following criteria:

(a) The product shall be diluted from the original concentration to 35% by mass within 5 minutes of the spill.
(b) The rate and estimated size of the spill shall be based upon maximum anticipated loading and discharge rates, the time required to stop flow of cargo in the event of tank overfill or a piping/hose failure, and the time necessary to begin application of dilution water with actuation at the cargo control location or on the navigating bridge.

LR 15.5(k) Suitable transverse coamings are to be arranged on the tank deck at the ends of the cargo area designated for carrying hydrogen peroxide in order to confine any deck spills to the areas protected by waterspray.

LR 15.5(l) The maximum anticipated loading rates are to be submitted by the Owner or Builder to enable the rate and size of spills to be estimated.

15.5.1.11 Only those hydrogen peroxide solutions which have a maximum decomposition rate of 1% per year at 25°C shall be carried. Certification from the shipper that the product meets this standard shall be presented to the master and kept on board. A technical representative of the manufacturer shall be on board to monitor the transfer operations and have the capability to test the stability of the hydrogen peroxide. He shall certify to the master that the cargo has been loaded in a stable condition.

15.5.1.12 Protective clothing that is resistant to hydrogen peroxide solutions shall be provided for each crew member involved in cargo-transfer operations. Protective clothing shall include nonflammable coveralls, suitable gloves, boots and eye protection.

LR 15.5(m) In all cases, the dedicated nature of the ship's service will be reflected in the class notation.

15.5.2 *Hydrogen peroxide solutions over 8% but not over 60% by mass*

15.5.2.1 The ship's shell plating shall not form any boundaries of tanks containing this product.

15.5.2.2 Hydrogen peroxide shall be carried in tanks thoroughly and effectively cleaned of all traces of previous cargoes and their vapours or ballast. Procedures for inspection, cleaning, passivation and loading of tanks shall be in accordance with MSC/Circ. 394. A certificate shall be on board the vessel indicating that the procedures in the circular have been followed. The passivation requirement may be waived by an Administration for domestic shipments of short duration. Particular care in this respect is essential to ensure the safe carriage of hydrogen peroxide:

(a) When hydrogen peroxide is carried no other cargoes shall be carried simultaneously.
(b) Tanks which have contained hydrogen peroxide may be used for other cargoes after cleaning in accordance with the procedures outlined in MSC/Circ.394.
(c) Consideration in design shall provide minimum internal tank structure, free draining, no entrapment and ease of visual inspection.

15.5.2.3 Cargo tanks and associated equipment shall be either pure aluminium (99.5%) or solid stainless steel of types suitable for use with hydrogen peroxide (e.g. 304, 304L, 316, 316L, 316Ti). Aluminium shall not be used for piping on deck. All non-metallic materials of construction for the containment system shall neither be attacked by hydrogen peroxide nor contribute to its decomposition.

LR 15.5(n) Full details of the passivation procedures are to be submitted.

15.5.2.4 Cargo tanks shall be separated by a cofferdam from fuel oil tanks or any other space containing materials incompatible with hydrogen peroxide.

15.5.2.5 Temperature sensors shall be installed at the top and bottom of the tank. Remote temperature readouts and continuous monitoring shall be located on the navigating bridge. If the temperature in the tank rises above 35°C, visible and audible alarms shall activate on the navigating bridge.

15.5.2.6 Fixed oxygen monitors (or gas-sampling lines) shall be provided in void spaces adjacent to tanks to detect leakage of the cargo into these spaces. The enhancement of flammability by oxygen enrichment shall be recognized. Remote readouts, continuous monitoring (if gas-sampling lines are used, intermittent sampling is satisfactory) and visible and audible alarms similar to those for the temperature sensors shall also be located on the navigating bridge. The visible and audible alarms shall activate if the oxygen concentration in these void spaces exceeds 30% by volume. Two portable oxygen monitors shall also be available as back-up systems.

LR 15.5(o) Leakages are to be dealt with to LR's satisfaction prior to loading a subsequent hydrogen peroxide cargo.

LR 15.5(p) Since hydrogen peroxide is not a heated cargo, heating systems should not, in general, be arranged within cargo tanks. Where heating systems are fitted these are also to be provided with leakage detection arrangements.

15.5.2.7 As a safeguard against uncontrolled decomposition, a cargo-jettisoning system shall be installed to discharge the cargo overboard. The cargo shall be jettisoned if the temperature rise of the cargo exceeds a rate of 2°C per hour over a 5-hour period or when the temperature in the tank exceeds 40°C.

15.5.2.8 Cargo tank venting systems with filtration shall have pressure/vacuum-relief valves for normal controlled venting, and a device for emergency venting, should tank pressure rise rapidly as a result of an uncontrolled decomposition rate, as stipulated in *Ch 1, 15.5 Hydrogen peroxide solutions*. These venting systems shall be designed in such a manner that there is no introduction of seawater into the cargo tank even under heavy sea conditions. Emergency venting shall be sized on the basis of tank design pressure and tank size.

LR 15.5(q) Emergency venting arrangements and calculations are to be submitted for approval.

15.5.2.9 A fixed water-spray system shall be provided for diluting and washing away any concentrated solution spilled on deck. The areas covered by the water-spray shall include the manifold/hose connections and the tank tops of those tanks designated for the carriage of hydrogen peroxide solutions. The minimum application rate shall satisfy the following criteria:

(a) The product shall be diluted from the original concentration to 35% by mass within 5 minutes of the spill.
(b) The rate and estimated size of the spill shall be based upon maximum anticipated loading and discharge rates, the time required to stop flow of the cargo in the event of tank overfill or a piping/hose failure, and the time necessary to begin application of dilution water with actuation at the cargo control location or on the navigating bridge.

LR 15.5(r) Suitable transverse coamings are to be arranged on the tank deck at the ends of the cargo area designated for carrying hydrogen peroxide in order to confine any deck spills to the areas protected by water spray.

LR 15.5(s) The maximum anticipated loading rates are to be submitted by the Owner or Builder to enable the rate and size of spills to be estimated.

15.5.2.10 Only those hydrogen peroxide solutions which have a maximum decomposition rate of 1% per year at 25°C shall be carried. Certification from the shipper that the product meets this standard shall be presented to the master and kept on board. A technical representative of the manufacturer shall be on board to monitor the transfer operations and have the capability to test the stability of the hydrogen peroxide. He shall certify to the master that the cargo has been loaded in a stable condition.

15.5.2.11 Protective clothing that is resistant to hydrogen peroxide shall be provided for each crew member involved in cargo-transfer operations. Protective clothing shall include coveralls that are nonflammable, suitable gloves, boots and eye protection.

15.5.2.12 During transfer of hydrogen peroxide the related piping system shall be separated from all other systems. Cargo hoses used for transfer of hydrogen peroxide shall be marked "FOR HYDROGEN PEROXIDE TRANSFER ONLY".

15.5.3 *Procedures for inspection, cleaning, passivation and loading of tanks for the carriage of hydrogen peroxide solutions 8-60%, which have contained other cargoes, or for the carriage of other cargoes after the carriage of hydrogen peroxide*

15.5.3.1 Tanks having contained cargoes other than hydrogen peroxide shall be inspected, cleaned and passivated before re-use for the transport of hydrogen peroxide solutions. The procedures for inspection and cleaning, as given in paragraphs *Ch 1, 15.5 Hydrogen peroxide solutions* below, apply to both stainless steel and pure aluminium tanks (see paragraph *Ch 1, 15.5 Hydrogen peroxide solutions*). Procedures for passivation are given in paragraph *Ch 1, 15.5 Hydrogen peroxide solutions* for stainless steel and *Ch 1, 15.5 Hydrogen peroxide solutions* for aluminium. Unless otherwise specified, all steps apply to the tanks and to all associated equipment having been in contact with the other cargo.

15.5.3.2 After unloading the previous cargo the tank shall be rendered safe and inspected for any residues, scale and rust.

15.5.3.3 Tanks and associated equipment shall be washed with clean filtered water. The water to be used shall at least have the quality of potable water with a low chlorine content.

15.5.3.4 Trace residues and vapours of the previous cargo shall be removed by steaming of tank and equipment.

15.5.3.5 Tank and equipment are washed again with clean water (quality as above) and dried, using filtered, oil-free air.

15.5.3.6 The atmosphere in the tank shall be sampled and investigated for the presence of organic vapours and oxygen concentration.

15.5.3.7 The tank shall be checked again by visual inspection for residues of the previous cargo, scale and rust as well as for any smell of the previous cargo.

15.5.3.8 If inspection or measurements indicate the presence of residues of the previous cargo or its vapours, actions described in paragraphs *Ch 1, 15.5 Hydrogen peroxide solutions* shall be repeated.

15.5.3.9 Tank and equipment made from stainless steel which have contained other cargoes than hydrogen peroxide or which have been under repair shall be cleaned and passivated, regardless of any previous passivation, according to the following procedure:

(a) New welds and other repaired parts shall be cleaned and finished using stainless steel wire brush, chisel, sandpaper or buff. Rough surfaces shall be given a smooth finish. A final polishing is necessary.
(b) Fatty and oily residues shall be removed by the use of appropriate organic solvents or detergent solutions in water. The use of chlorine-containing compounds shall be avoided as they can seriously interfere with passivation.
(c) The residues of the degreasing agent shall be removed, followed by a washing with water.
(d) In the next step, scale and rust shall be removed by the application of acid (e.g. a mixture of nitric and hydrofluoric acids), followed again by a washing with clean water.
(e) All the metal surfaces which can come into contact with hydrogen peroxide shall be passivated by the application of nitric acid of a concentration between 10 and 35% by mass. The nitric acid must be free from heavy metals, other oxidizing agents or hydrogen fluoride. The passivation process shall continue for 8 to 24 h, depending upon the concentration of acid, the ambient temperature and other factors. During this time a continuous contact between the surfaces to be passivated and the nitric acid shall be ensured. In the case of large surfaces this may be achieved by recirculating the acid. Hydrogen gas may be evolved in the passivation process, leading to the presence of an explosive atmosphere in the tanks. Therefore, appropriate measures must be taken to avoid the build-up or the ignition of such an atmosphere.
(f) After passivation the surfaces shall be thoroughly washed with clean filtered water. The washing process shall be repeated until the effluent water has the same pH value as the incoming water.
(g) Surfaces treated according to the above steps may cause some decomposition when coming into contact with hydrogen peroxide for the first time. This decomposition will cease after a short time (usually within two or three days). Therefore an additional flushing with hydrogen peroxide for a period of at least two days is recommended.
(h) Only degreasing agents and acid cleaning agents which have been recommended for this purpose by the manufacturer of the hydrogen peroxide shall be used in the process.

15.5.3.10 Tanks and equipment made from aluminium and which have contained cargoes other than hydrogen peroxide, or which have been under repair, shall be cleaned and passivated. The following is an example of a recommended procedure:

(a) The tank shall be washed with a solution of a sulphonated detergent in hot water, followed by a washing with water.
(b) The surface shall then be treated for 15 to 20 min with a solution of sodium hydroxide of a concentration of 7% by mass or treated for a longer period with a less concentrated solution (e.g. for 12 h with 0.4 to 0.5% sodium hydroxide). To prevent excessive corrosion at the bottom of the tank when treating with more concentrated solutions of sodium hydroxide, water shall be added continuously to dilute the sodium hydroxide solution which collects there.
(c) The tank shall be thoroughly washed with clean, filtered water. As soon as possible after washing, the surface shall be passivated by the application of nitric acid of a concentration between 30 and 35% by mass. The passivation process shall continue for 16 to 24 h. During this time a continuous contact between the surfaces to be passivated and the nitric acid shall be ensured.
(d) After passivation the surfaces shall be thoroughly washed with clean, filtered water. The washing process shall be repeated until the effluent water has the same pH value as the incoming water.
(e) A visual inspection shall be made to ensure that all surfaces have been treated. It is recommended that an additional flushing is carried out for a minimum of 24 h with dilute hydrogen peroxide solution of a concentration approximately 3% by mass.

15.5.3.11 The concentration and stability of the hydrogen peroxide solution to be loaded shall be determined.

15.5.3.12 The hydrogen peroxide is loaded under intermittent visual supervision of the interior of the tank from an appropriate opening.

15.5.3.13 If substantial bubbling is observed which does not disappear within 15 min after the completion of loading, the contents of the tank shall be unloaded and disposed of in an environmentally safe manner. The tank and equipment shall then be repassivated as described above.

15.5.3.14 The concentration and stability of the hydrogen peroxide solution shall be determined again. If the same values are obtained within the limits of error as in paragraph 15.5.3.10, the tank is considered to be properly passivated and the cargo ready for shipment.

15.5.3.15 Actions described in paragraphs *Ch 1, 15.5 Hydrogen peroxide solutions* shall be carried out under the supervision of the master or shipper. Actions described in paragraphs *Ch 1, 15.5 Hydrogen peroxide solutions* shall be carried out under the on-

site supervision and responsibility of a representative of the hydrogen peroxide manufacturer or under supervision and responsibility of another person familiar with the safety-relevant properties of hydrogen peroxide.

15.5.3.16 The following procedure shall be applied when tanks having contained hydrogen peroxide solution are to be used for other products (unless otherwise specified, all steps apply to the tanks and to all associated equipment having been in contact with hydrogen peroxide):

(a) Hydrogen peroxide cargo residue shall be drained as completely as possible from tanks and equipment.
(b) Tanks and equipment shall be rinsed with clean water, and subsequently thoroughly washed with clean water.
(c) The interior of the tank shall be dried and inspected for any residues.

Steps .1 to .3, in *Ch 1, 15.5 Hydrogen peroxide solutions*, shall be carried out under the supervision of the master or the shipper. Step .3 in paragraph *Ch 1, 15.5 Hydrogen peroxide solutions* shall be carried out by a person familiar with the safety-relevant properties of the chemical to be transported and of hydrogen peroxide.

SPECIAL CAUTIONS :

Note 1 Hydrogen peroxide decomposition may enrich the atmosphere with oxygen and appropriate precautions shall be observed.

Note 2 Hydrogen gas may be evolved in the passivation processes described in paragraphs *Ch 1, 15.5 Hydrogen peroxide solutions*, *Ch 1, 15.5 Hydrogen peroxide solutions*, leading to the presence of an explosive atmosphere in the tank. Therefore, appropriate measures must be taken to avoid the build-up or the ignition of such an atmosphere.

15.6 Motor fuel anti-knock compounds (containing lead alkyls)

15.6.1 Tanks used for these cargoes shall not be used for the transportation of any other cargo except those commodities to be used in the manufacture of motor fuel anti-knock compounds containing lead alkyls.

15.6.2 If a cargo pump-room is located on deck level according to *Ch 1, 15.18 Special cargo pump-room requirements*, the ventilation arrangements shall be in compliance with *Ch 1, 15.17 Increased ventilation requirements*.

15.6.3 Entry into cargo tanks used for the transportation of these cargoes is not permitted unless approved by the Administration.

15.6.4 Air analysis shall be made for lead content to determine if the atmosphere is satisfactory prior to allowing personnel to enter the cargo pump-room or void spaces surrounding the cargo tank.

LR 15.6(a) Warning notices are to be posted accordingly.

15.7 Phosphorus, yellow or white

LR 15.7(a) The following requirements apply to carriage at a cargo temperature in the range between 45°C and 60°C.

LR 15.7(b) The liquid is to be carried in independent, externally insulated tanks. The tanks are to be supported and keyed such as to permit free expansion in all directions and eliminate heat bridges which may transmit thermal stresses to the ship's hull. Account is to be taken of the dynamic loading which will be experienced by the tanks, supports and keys in service. Calculations are to be submitted.

LR 15.7(c) The hull arrangements may require to incorporate two longitudinal bulkheads for strength reasons in view of the relative density of phosphorus.

15.7.1 Phosphorus shall, at all times, be loaded, carried and discharged under a water pad of 760 mm minimum depth. During discharge operations, arrangements shall be made to ensure that water occupies the volume of phosphorus discharged. Any water discharged from a phosphorus tank shall be returned only to a shore installation.

15.7.2 Tanks shall be designed and tested to a minimum equivalent water head of 2.4 m above the top of the tank, under designed loading conditions, taking into account the depth, relative density and method of loading and discharge of the phosphorus.

15.7.3 Tanks shall be so designed as to minimize the interfacial area between the liquid phosphorus and its water pad.

15.7.4 A minimum ullage space of 1% shall be maintained above the water pad. The ullage space shall be filled with inert gas or naturally ventilated by two cowled standpipes terminating at different heights but at least 6 m above the deck and at least 2 m above the pump-house top.

15.7.5 All openings shall be at the top of cargo tanks, and fittings and joints attached thereto shall be of materials resistant to phosphorus pentoxide.

15.7.6 Phosphorus shall be loaded at a temperature not exceeding 60°C.

15.7.7 Tank heating arrangements shall be external to tanks and have a suitable method of temperature control to ensure that the temperature of the phosphorus does not exceed 60°C. A high-temperature alarm shall be fitted.

15.7.8 A water drench system acceptable to the Administration shall be installed in all void spaces surrounding the tanks. The system shall operate automatically in the event of an escape of phosphorus.

15.7.9 Void spaces referred to in *Ch 1, 15.7 Phosphorus, yellow or white 15.7.8* shall be provided with effective means of mechanical ventilation which shall be capable of being sealed off quickly in an emergency.

15.7.10 Loading and discharge of phosphorus shall be governed by a central system on the ship which, in addition to incorporating high-level alarms, shall ensure that no overflow of tanks is possible and that such operations can be stopped quickly in an emergency from either ship or shore.

15.7.11 During cargo transfer, a water hose on deck shall be connected to a water supply and kept flowing throughout the operation so that any spillage of phosphorus may be washed down with water immediately.

LR 15.7(d) Notices are to be posted in the wheelhouse and cargo control room to the effect that a water hose on deck should be connected to a water supply which is to be kept flowing throughout the cargo transfer operation.

15.7.12 Ship-to-shore loading and discharge connections shall be of a type approved by the Administration.

15.8 Propylene oxide and mixtures of ethylene oxide/propylene oxide with an ethylene oxide content of not more than 30% by weight

15.8.1 Products transported under the provisions of this section shall be acetylene-free.

15.8.2 Unless cargo tanks are properly cleaned, these products shall not be carried in tanks which have contained as one of the three previous cargoes any products known to catalyse polymerization, such as:

(a) mineral acids (e.g. sulphuric, hydrochloric, nitric);
(b) carboxylic acids and anhydrides (e.g. formic, acetic);
(c) halogenated carboxylic acids (e.g. chloracetic);
(d) sulphonic acids (e.g. benzenesulphonic);
(e) caustic alkalis (e.g. sodium hydroxide, potassium hydroxide);
(f) ammonia and ammonia solutions;
(g) amines and amine solutions; and
(h) oxidizing substances.

15.8.3 Before loading, tanks shall be thoroughly and effectively cleaned, to remove all traces of previous cargoes from tanks and associated pipework, except where the immediately prior cargo has been propylene oxide or ethylene oxide/propylene oxide mixtures. Particular care shall be taken in the case of ammonia in tanks made of steel other than stainless steel.

15.8.4 In all cases, the effectiveness of cleaning procedures for tanks and associated pipework shall be checked by suitable testing or inspection, to ascertain that no traces of acidic or alkaline materials remain that might create a hazardous situation in the presence of these products.

15.8.5 Tanks shall be entered and inspected prior to each initial loading of these products to ensure freedom from contamination, heavy rust deposits and visible structural defects. When cargo tanks are in continuous service for these products, such inspections shall be performed at intervals of not more than two years.

15.8.6 Tanks for the carriage of these products shall be of steel or stainless steel construction.

15.8.7 Tanks for the carriage of these products may be used for other cargoes after thorough cleaning of tanks and associated pipework systems by washing or purging.

15.8.8 All valves, flanges, fittings and accessory equipment shall be of a type suitable for use with the products and shall be constructed of steel or stainless steel in accordance with recognized standards. Discs or disc faces, seats and other wearing parts of valves shall be made of stainless steel containing not less than 11% chromium.

15.8.9 Gaskets shall be constructed of materials which do not react with, dissolve in, or lower the autoignition temperature of these products and which are fire-resistant and possess adequate mechanical behaviour. The surface presented to the cargo shall be polytetrafluoroethylene (PTFE), or materials giving a similar degree of safety by their inertness. Spirally wound stainless steel, with a filler of PTFE or similar fluorinated polymer, may be accepted.

15.8.10 Insulation and packing, if used, shall be of a material which does not react with, dissolve in, or lower the autoignition temperature of these products.

15.8.11 The following materials are generally found unsatisfactory for gaskets, packing and similar uses in containment systems for these products and would require testing before being approved by the Administration:

(a) neoprene or natural rubber, if it comes into contact with the products.

(b) asbestos, or binders used with asbestos.
(c) materials containing oxides of magnesium, such as mineral wools.

15.8.12 Threaded joints shall not be permitted in the cargo liquid and vapour lines.

15.8.13 Filling and discharge piping shall extend to within 100 mm of the bottom of the tank or any sump pit.

15.8.14.1 The containment system for a tank containing these products shall have a valved vapour-return connection.

15.8.14.2 The products shall be loaded and discharged in such a manner that venting of the tanks to atmosphere does not occur. If vapour return to shore is used during tank loading, the vapour-return system connected to a containment system for the product shall be independent of all other containment systems.

15.8.14.3 During discharge operations, the pressure in the cargo tank must be maintained above 0.007 MPa gauge.

15.8.15 The cargo may be discharged only by deepwell pumps, hydraulically operated submerged pumps, or inert-gas displacement. Each cargo pump shall be arranged to ensure that the product does not heat significantly if the discharge line from the pump is shut off or otherwise blocked.

15.8.16 Tanks carrying these products shall be vented independently of tanks carrying other products. Facilities shall be provided for sampling the tank contents without opening the tank to atmosphere.

15.8.17 Cargo hoses used for transfer of these products shall be marked "FOR ALKYLENE OXIDE TRANSFER ONLY".

15.8.18 Cargo tanks, void spaces and other enclosed spaces adjacent to an integral gravity cargo tank carrying propylene oxide shall either contain a compatible cargo (those cargoes specified in *Ch 1, 15.8 Propylene oxide and mixtures of ethylene oxide/ propylene oxide with an ethylene oxide content of not more than 30% by weight* are examples of substances considered incompatible) or be inerted by injection of a suitable inert gas. Any hold space in which an independent cargo tank is located shall be inerted. Such inerted spaces and tanks shall be monitored for these products and oxygen. The oxygen content of these spaces shall be maintained below 2%. Portable sampling equipment is satisfactory.

15.8.19 In no case shall air be allowed to enter the cargo pump or piping system while these products are contained within the system.

15.8.20 Prior to disconnecting shore-lines, the pressure in liquid and vapour lines shall be relieved through suitable valves installed at the loading header. Liquid and vapour from these lines shall not be discharged to atmosphere.

15.8.21 Propylene oxide may be carried in pressure tanks or in independent or integral gravity tanks. Ethylene oxide/propylene oxide mixtures shall be carried in independent gravity tanks or pressure tanks. Tanks shall be designed for the maximum pressure expected to be encountered during loading, conveying and discharging cargo.

15.8.22.1 Tanks for the carriage of propylene oxide with a design pressure less than 0.06 MPa gauge and tanks for the carriage of ethylene oxide/propylene oxide mixtures with a design pressure of less than 0.12 MPa gauge shall have a cooling system to maintain the cargo below the reference temperature.

15.8.22.2 The refrigeration requirement for tanks with a design pressure less than 0.06 MPa gauge may be waived by the Administration for ships operating in restricted areas or on voyages of restricted duration, and account may be taken in such cases of any insulation of the tanks. The area and times of year for which such carriage would be permitted shall be included in the conditions of carriage of the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

15.8.23.1 Any cooling system shall maintain the liquid temperature below the boiling temperature at the containment pressure. At least two complete cooling plants, automatically regulated by variations within the tanks, shall be provided. Each cooling plant shall be complete with the necessary auxiliaries for proper operation. The control system shall also be capable of being manually operated. An alarm shall be provided to indicate malfunctioning of the temperature controls. The capacity of each cooling system shall be sufficient to maintain the temperature of the liquid cargo below the reference temperature of the system.

15.8.23.2 An alternative arrangement may consist of three cooling plants, any two of which shall be sufficient to maintain the liquid temperature below the reference temperature.

15.8.23.3 Cooling media which are separated from the products by a single wall only shall be nonreactive with the products.

15.8.23.4 Cooling systems requiring compression of the products shall not be used.

15.8.24 Pressure-relief-valve settings shall not be less than 0.02 MPa gauge and for pressure tanks not greater than 0.7 MPa gauge for the carriage of propylene oxide and not greater than 0.53 MPa gauge for the carriage of propylene oxide/ethylene oxide mixtures.

15.8.25.1 The piping system for tanks to be loaded with these products shall be separated (as defined in *Ch 1, 3.1 Cargo segregation 3.1.4*) from piping systems for all other tanks, including empty tanks. If the piping system for the tanks to be loaded is not independent (as defined in *Ch 1, 1.3 Definitions 1.3.18*), the required piping separation shall be accomplished by the removal of spool-pieces, valves, or other pipe section and the installation of blank flanges at these locations. The required separation applies to all liquid and vapour piping, liquid and vapour vent lines and any other possible connections, such as common inert-gas supply lines.

15.8.25.2 These products may be transported only in accordance with cargo-handling plans that have been approved by the Administration. Each intended loading arrangement shall be shown on a separate cargo-handling plan. Cargo-handling plans shall show the entire cargo piping system and the locations for installation of blank flanges needed to meet the above piping separation requirements. A copy of each approved cargo-handling plan shall be maintained on board the ship. The International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall be endorsed to include reference to the approved cargo-handling plans.

15.8.25.3 Before each initial loading of these products and before every subsequent return to such service, certification verifying that the required piping separation has been achieved shall be obtained from a responsible person acceptable to the port Administration and carried on board the ship. Each connection between a blank flange and a pipeline flange shall be fitted with a wire and seal by the responsible person to ensure that in-advertent removal of the blank flange is impossible.

15.8.26.1 No cargo tanks shall be more than 98% liquid-full at the reference temperature.

15.8.26.2 The maximum volume to which a cargo tank shall be loaded is:

$$V_L = 0.98V\frac{\rho_R}{\rho_L}$$

Where

V_L = maximum volume to which the tank may be loaded

V = volume of the tank

ρ_R = density of cargo at the reference temperature

ρ_L = density of cargo at the loading temperature and pressure

15.8.26.3 The maximum allowable tank filling limits for each cargo tank shall be indicated for each loading temperature which may be applied and for the applicable maximum reference temperature, on a list to be approved by the Administration. A copy of the list shall be permanently kept on board by the master.

15.8.27 The cargo shall be carried under a suitable protective padding of nitrogen gas. An automatic nitrogen make-up system shall be installed to prevent the tank pressure falling below 0.007 MPa gauge in the event of product temperature fall due to ambient conditions or maloperation of refrigeration systems. Sufficient nitrogen shall be available on board to satisfy the demand of the automatic pressure control. Nitrogen of commercially pure quality (99.9% by volume) shall be used for padding. A battery of nitrogen bottles connected to the cargo tanks through a pressure-reduction valve satisfies the intention of the expression "automatic" in this context.

15.8.28 The cargo tank vapour space shall be tested prior to and after loading to ensure that the oxygen content is 2% by volume or less.

15.8.29 A water-spray system of sufficient capacity shall be provided to blanket effectively the area surrounding the loading manifold, the exposed deck piping associated with product handling, and the tank domes. The arrangement of piping and nozzles shall be such as to give a uniform distribution rate of 10 l/m^2/min. Remote manual operation shall be arranged such that remote starting of pumps supplying the water-spray system and remote operation of any normally closed valves in the system can be carried out from a suitable location outside the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected. The water-spray system shall be capable of both local and remote manual operation, and the arrangement shall ensure that any spilled cargo is washed away. Additionally, a water hose with pressure to the nozzle, when atmospheric temperatures permit, shall be connected ready for immediate use during loading and unloading operations.

15.8.30 A remotely operated, controlled closing-rate, shutoff valve shall be provided at each cargo-hose connection used during cargo transfer.

15.9 Sodium chlorate solution (50% or less by mass)

15.9.1 Tanks and associated equipment, which have contained this product may be used for other cargoes after thorough cleaning by washing or purging.

15.9.2 In the event of spillage of this product, all spilled liquid shall be thoroughly washed away without delay. To minimize fire risk, spillage shall not be allowed to dry out.

15.10 Sulphur (molten)

LR 15.10(a) The following requirements apply to carriage within the temperature range 138°C to 155°C.

LR 15.10(b) The liquid is to be carried in independent, externally insulated tanks which are so supported and keyed as to permit free expansion in all directions and eliminate heat bridges which may transmit thermal stresses to the hull. Account is to be taken of the dynamic loading which will be experienced by the tanks, supports and keys in service. Calculations are to be submitted.

LR 15.10(c) The internal arrangements at the top of the tank are to be such as to minimise the possible entrapment of pockets of hazardous vapour. An expansion trunk is to be arranged to ensure that the level of sulphur remains in the trunk when the tank is fully loaded.

LR 15.10(d) The hull arrangements may require to incorporate two longitudinal bulkheads for strength reasons in view of the relative density of sulphur liquid.

15.10.1 Cargo tank ventilation shall be provided to maintain the concentration of hydrogen sulphide below one half of its lower explosive limit through-out the cargo tank vapour space for all conditions of carriage (i.e. below 1.85% by volume).

15.10.2 Where mechanical ventilation systems are used for maintaining low gas concentrations in cargo tanks, an alarm system shall be provided to give warning if the system fails.

15.10.3 Ventilation systems shall be so designed and arranged as to preclude depositing of sulphur within the system.

15.10.4 Openings to void spaces adjacent to cargo tanks shall be so designed and fitted as to prevent the entry of water, sulphur or cargo vapour.

15.10.5 Connections shall be provided to permit sampling and analysing of vapour in void spaces.

15.10.6 Cargo temperature controls shall be provided to ensure that the temperature of the sulphur does not exceed 155°C.

15.10.7 Sulphur (molten) has a flashpoint above 60°C ; however, electrical equipment shall be certified safe for gases evolved.

15.11 Acids

15.11.1 The ship's shell plating shall not form any boundaries of tanks containing mineral acids.

15.11.2 Proposals for lining steel tanks and related piping systems with corrosion-resistant materials may be considered by the Administration. The elasticity of the lining shall not be less than that of the supporting boundary plating.

LR 15.11(a) The internal cargo tank surface is to be smooth and free of obstruction, and the arrangements at corners are to be appropriate to the intended lining arrangements.

LR 15.11(b) A corrosion protection lining, when applied to the tank or piping surfaces, is to be applied in solid state. Application in liquid state is not permitted because it may be difficult to ensure adequate control of the thickness of the lining at edges and corners, and to ensure the necessary control of the curing process. A lining approved for use with acids is an acid-resistant material that is applied to the tank or piping system in a solid state with a defined elasticity property, which is to be greater than the elasticity of the structural steel.

15.11.3 Unless constructed wholly of corrosion-resistant materials or fitted with an approved lining, the plating thickness shall take into account the corrosivity of the cargo.

15.11.4 Flanges of the loading and discharge manifold connections shall be provided with shields, which may be portable, to guard against the danger of the cargo being sprayed; and in addition, drip trays shall also be provided to guard against leakage on to the deck.

15.11.5 Because of the danger of evolution of hydrogen when these substances are being carried, the electrical arrangements shall comply with *Ch 1, 10.1 General*. The certified safe type equipment shall be suitable for use in hydrogen/air mixtures. Other sources of ignition shall not be permitted in such spaces.

15.11.6 Substances subjected to the requirements of this section shall be segregated from fuel oil tanks, in addition to the segregation requirements in *Ch 1, 3.1 Cargo segregation 3.1.1*.

15.11.7 Provision shall be made for suitable apparatus to detect leakage of cargo into adjacent spaces.

15.11.8 The cargo pump-room bilge pumping and drainage arrangements shall be of corrosion-resistant materials.

15.12 Toxic products

15.12.1 Exhaust openings of tank vent systems shall be located:

(a) at a height of B/3 or 6 m, whichever is greater, above the weather deck or, in the case of a deck tank, the access gangway;
(b) not less than 6 m above the fore-and-aft gangway, if fitted within 6 m of the gangway;
(c) 15 m from any opening or air intake to any accommodation and service spaces; and
(d) the vent height may be reduced to 3 m above the deck or fore-and-aft gangway, as applicable, provided high-velocity vent valves of an approved type, directing the vapour/air mixture upwards in an unimpeded jet with an exit velocity of at least 30 m/s, are fitted.

15.12.2 Tank venting systems shall be provided with a connection for a vapour-return line to the shore installation.

LR 15.12(a) Vapour return lines are to be fitted with shut-off valves and blank flanges.

15.12.3 Products shall:

(a) not be stowed adjacent to fuel oil tanks;

(b) have separate piping systems; and

(c) have tank vent systems separate from tanks containing non-toxic products.

15.12.4 Cargo tank relief-valve settings shall be a minimum of 0.02 MPa gauge.

15.13 Cargoes protected by additives

15.13.1 Certain cargoes with a reference in *column o* in the table of *chapter 17*, by the nature of their chemical make-up, tend, under certain conditions of temperature, exposure to air or contact with a catalyst, to undergo polymerization, decomposition, oxidation or other chemical changes. Mitigation of this tendency is carried out by introducing small amounts of chemical additives into the liquid cargo or controlling the cargo tank environment.

15.13.2 Ships carrying these cargoes shall be so designed as to eliminate from the cargo tanks and cargo-handling system any material of construction or contaminants which could act as a catalyst or destroy the inhibitor.

15.13.3 Care shall be taken to ensure that these cargoes are sufficiently protected to prevent deleterious chemical change at all times during the voyage. Ships carrying such cargoes shall be provided with a certificate of protection from the manufacturer, and kept during the voyage, specifying:

(a) the name and amount of additive present;

(b) whether the additive is oxygen-dependent;

(c) date additive was put in the product and duration of effectiveness;

(d) any temperature limitations qualifying the additives' effective lifetime; and

(e) the action to be taken shall the length of voyage exceed the effective lifetime of the additives.

15.13.4 Ships using the exclusion of air as the method of preventing oxidation of the cargo shall comply with *Ch 1, 9.1 General 9.1.3*.

15.13.5 When a product containing an oxygen-dependent inhibitor is to be carried:

(a) in a ship for which inerting is required under SOLAS regulation II-2/ *5.5 Inert gas systems*, as amended, the application of inert gas shall not take place before loading or during the voyage, but shall be applied before commencement of unloading [5];

(b) in a ship to which SOLAS regulation II-2/ *5.5 Inert gas systems*, as amended, does not apply, the product may be carried without inertion (in tanks of a size not greater than 3,000 m^3). If inertion is to be applied on such a ship, then the application of inert gas shall not take place before loading or during the voyage, but shall be applied before commencement of unloading [5].

15.13.6 Venting systems shall be of a design that eliminates blockage from polymer build-up. Venting equipment shall be of a type that can be checked periodically for adequacy of operation.

15.13.7 Crystallization or solidification of cargoes normally carried in the molten state can lead to depletion of inhibitor in parts of the tank's contents. Subsequent remelting can thus yield pockets of uninhibited liquid, with the accompanying risk of dangerous polymerization. To prevent this, care shall be taken to ensure that at no time are such cargoes allowed to crystallize or solidify, either wholly or partially, in any part of the tank. Any required heating arrangements shall be such as to ensure that in no part of the tank does cargo become overheated to such an extent that any dangerous polymerization can be initiated. If the temperature from steam coils would induce overheating, an indirect low-temperature heating system shall be used.

15.14 Cargoes with a vapour pressure greater than 1,013 bar absolute at 37,8°C

15.14.1 For a cargo referenced in *column o* in the table of *chapter 17* to this section, a mechanical refrigeration system shall be provided unless the cargo system is designed to withstand the vapour pressure of the cargo at 45°C. Where the cargo system is designed to withstand the vapour pressure of the cargo at 45°C, and no refrigeration system is provided, a notation shall be made in the conditions of carriage on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk to indicate the required relief-valve setting for the tanks.

15.14.2 A mechanical refrigeration system shall maintain the liquid temperature below the boiling temperature at the cargo tank design pressure.

[5] Refer to*Circular* on Products requiring oxygen-dependent inhibitors.

15.14.3 When ships operate in restricted areas and at restricted times of the year, or on voyages of limited duration, the Administration involved may agree to waive requirements for a refrigeration system. A notation of any such agreement, listing geographic area restrictions and times of the year, or voyage duration limitations, shall be included in the conditions of carriage on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

15.14.4 Connections shall be provided for returning expelled gases to shore during loading.

LR 15.14(a) Vapour return lines are to be fitted with shut-off valves and blank flanges.

15.14.5 Each tank shall be provided with a pressure gauge which indicates the pressure in the vapour space above the cargo.

15.14.6 Where the cargo needs to be cooled, thermometers shall be provided at the top and bottom of each tank.

15.14.7.1 No cargo tanks shall be more than 98% liquid-full at the reference temperature (R).

15.14.7.2 The maximum volume (V_L) of cargo to be loaded in a tank shall be:

$$V_L = 0.98V\frac{\rho_R}{\rho_L}$$

Where

V = volume of the tank

ρ_R = density of cargo at the reference temperature (R)

ρ_L = density of cargo at the loading temperature

15.14.7.3 The maximum allowable tank filling limits for each cargo tank shall be indicated for each loading temperature which may be applied, and for the applicable maximum reference temperature, on a list approved by the Administration. A copy of the list shall be permanently kept on board by the master.

15.15 Cargoes with low ignition temperature and wide flammability range

15.15.1 Deleted.

15.16 Cargo contamination

15.16.1 Deleted.

15.16.2 Where *column o* in the table of *chapter 17* refers to this section, water shall not be allowed to contaminate this cargo. In addition, the following provisions apply:

(a) Air inlets to pressure/vacuum-relief valves of tanks containing the cargo shall be situated at least 2 m above the weather deck.

(b) Water or steam shall not be used as the heat-transfer media in a cargo temperature control system required by *chapter 7*.

(c) The cargo shall not be carried in cargo tanks adjacent to permanent ballast or water tanks unless the tanks are empty and dry.

(d) The cargo shall not be carried in tanks adjacent to slop tanks or cargo tanks containing ballast or slops or other cargoes containing water which may react in a dangerous manner. Pumps, pipes or vent lines serving such tanks shall be separate from similar equipment serving tanks containing the cargo. Pipelines from slop tanks or ballast lines shall not pass through tanks containing the cargo unless encased in a tunnel.

15.17 Increased ventilation requirements

15.17.1 For certain products, the ventilation system as described in *Ch 1, 12.1 Spaces normally entered during cargo-handling operations 12.1.3* shall have a minimum capacity of at least 45 changes of air per hour, based upon the total volume of space. The ventilation system exhaust ducts shall discharge at least 10 m away from openings into accommodation spaces, work areas or other similar spaces, and intakes to ventilation systems, and at least 4 m above the tank deck.

15.18 Special cargo pump-room requirements

15.18.1 For certain products, the cargo pump-room shall be located on the deck level or cargo pumps shall be located in the cargo tank. The Administration may give special consideration to cargo pump-rooms below deck.

15.19 Overflow control

15.19.1 The provisions of this section are applicable where specific reference is made in *column o* in the table of *chapter 17*, and are in addition to the requirements for gauging devices.

15.19.2 In the event of a power failure on any system essential for safe loading, an alarm shall be given to the operators concerned.

15.19.3 Loading operations shall be terminated at once in the event of any system essential for safe loading becoming inoperative.

15.19.4 Level alarms shall be capable of being tested prior to loading.

15.19.5 The high-level alarm system required under *Ch 1, 15.19 Overflow control 15.19.6* shall be independent of the overflow-control system required by *Ch 1, 15.19 Overflow control 15.19.7* and shall be independent of the equipment required by *Ch 1, 13.1 Gauging*.

15.19.6 Cargo tanks shall be fitted with a visual and audible high-level alarm which complies with *Ch 1, 15.19 Overflow control 15.19.1* and which indicates when the liquid level in the cargo tank approaches the normal full condition.

15.19.7 A tank overflow-control system required by this section shall:

(a) come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition;
(b) give a visual and audible tank-overflow alarm to the ship's operator; and
(c) provide an agreed signal for sequential shutdown of onshore pumps or valves or both and of the ship's valves. The signal, as well as the pump and valve shutdown, may be dependent on operator's intervention. The use of shipboard automatic closing valves shall be permitted only when specific approval has been obtained from the Administration and the port State authority concerned.

15.19.8 The loading rate (LR) of the tank shall not exceed:

$$LR = \frac{3600U}{t}\left(m^3/h\right)$$

where

U = ullage volume (m^3) at operating signal level;

t = time(s) needed from the initiating signal to fully stopping the cargo flow into the tank, being the sum of times needed for each step in sequential operations such as operator's responses to signals, stopping pumps and closing valves;

and shall also take into account the pipeline system design pressure.

15.20 Alkyl (C_7 - C_7) nitrates, all isomers

15.20.1 The carriage temperature of the cargo shall be maintained below 100°C to prevent the occurrence of a self-sustaining, exothermic decomposition reaction.

15.20.2 The cargo may not be carried in independent pressure vessels permanently affixed to the vessel's deck unless:

(a) the tanks are sufficiently insulated from fire; and
(b) the vessel has a water deluge system for the tanks such that the cargo temperature is maintained below 100°C and the temperature rise in the tanks does not exceed 1.5°C per hour for a fire of 650°C.

15.21 Temperature sensors

15.21.1 Temperature sensors shall be used to monitor the cargo pump temperature to detect overheating due to pump failures.

Operational Requirements

16.1 Maximum allowable quantity of cargo per tank

16.1.1 The quantity of a cargo required to be carried in a type 1 ship shall not exceed 1,250 m^3 in any one tank.

16.1.2 The quantity of cargo required to be carried in a type 2 ship shall not exceed 3,000 m^3 in any one tank.

16.1.3 Tanks carrying liquids at ambient temperatures shall be so loaded as to avoid the tank becoming liquid-full during the voyage, having due regard to the highest temperature which the cargo may reach.

16.2 Cargo information

16.2.1 A copy of this Code, or national regulations incorporating the provisions of this Code, shall be on board every ship covered by this Code.

16.2.2 Any cargo offered for bulk shipment shall be indicated in the shipping documents by the product name, under which it is listed in *chapter 17* or *18* of the Code or the latest edition of MEPC.2/Circ. or under which it has been provisionally assessed. Where the cargo is a mixture, an analysis indicating the dangerous components contributing significantly to the total hazard of the product shall be provided, or a complete analysis if this is available. Such an analysis shall be certified by the manufacturer or by an independent expert acceptable to the Administration.

16.2.3 Information shall be on board, and available to all concerned, giving the necessary data for the safe carriage of the cargo in bulk. Such information shall include a cargo stowage plan, to be kept in an accessible place, indicating all cargo on board, including each dangerous chemical carried:

(a) a full description of the physical and chemical properties, including reactivity, necessary for the safe containment of the cargo;
(b) action to be taken in the event of spills or leaks;
(c) countermeasures against accidental personal contact;
(d) fire-fighting procedures and fire-fighting media;
(e) procedures for cargo transfer, tank cleaning, gas-freeing and ballasting; and
(f) for those cargoes required to be stabilized or inhibited, the cargo shall be refused if the certificate required by these paragraphs is not supplied.

16.2.4 If sufficient information, necessary for the safe transportation of the cargo, is not available, the cargo shall be refused.

16.2.5 Cargoes which evolve highly toxic imperceptible vapours shall not be transported unless perceptible additives are introduced into the cargo.

16.2.6 Where *column o* in the table of *chapter 17* refers to this paragraph, the cargo's viscosity at 20°C shall be specified on a shipping document, and if the cargo's viscosity exceeds 50 mPa.s at 20°C, the temperature at which the cargo has a viscosity of 50 mPa.s shall be specified in the shipping document.

16.2.7 Deleted.

16.2.8 Deleted.

16.2.9 Where *column o* in the table of *chapter 17* refers to this paragraph, the cargo's melting point shall be indicated in the shipping document.

16.3 Personnel training

16.3.1 All personnel shall be adequately trained in the use of protective equipment and have basic training in the procedures appropriate to their duties necessary under emergency conditions.

16.3.2 Personnel involved in cargo operations shall be adequately trained in handling procedures.

16.3.3 Officers shall be trained in emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them shall be instructed and trained in essential first aid for cargoes carried, based on the guidelines developed by the Organization[6].

16.4 Opening of and entry into cargo tanks

16.4.1 During handling and carriage of cargoes producing flammable and/or toxic vapours or when ballasting after the discharge of such cargo, or when loading or unloading cargo, cargo tank lids shall always be kept closed. With any hazardous cargo, cargo tank lids, ullage and sighting ports and tank washing access covers shall be open only when necessary.

16.4.2 Personnel shall not enter cargo tanks, void spaces around such tanks, cargo-handling spaces or other enclosed spaces unless:

(a) the compartment is free of toxic vapours and not deficient in oxygen; or

[6] Refer to the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), which provides advice on the treatment of casualties in accordance with the symptoms exhibited as well as equipment and antidotes that may be appropriate for treating the casualty and to the relevant provisions of the STCW Code, *parts A* and *B*.

(b) personnel wear breathing apparatus and other necessary protective equipment, and the entire operation is under the close supervision of a responsible officer.

16.4.3 Personnel shall not enter such spaces when the only hazard is of a purely flammable nature, except under the close supervision of a responsible officer.

16.5 Stowage of cargo samples

16.5.1 Samples which have to be kept on board shall be stowed in a designated space situated in the cargo area or, exceptionally, elsewhere, subject to the approval of the Administration.

16.5.2 The stowage space shall be:

(a) cell-divided in order to avoid shifting of the bottles at sea;

(b) made of material fully resistant to the different liquids intended to be stowed; and

(c) equipped with adequate ventilation arrangements.

16.5.3 Samples which react with each other dangerously shall not be stowed close to each other.

16.5.4 Samples shall not be retained on board longer than necessary.

16.6 Cargoes not to be exposed to excessive heat

16.6.1 Where the possibility exists of a dangerous reaction of a cargo, such as polymerization, decomposition, thermal instability or evolution of gas, resulting from local overheating of the cargo in either the tank or associated pipelines, such cargo shall be loaded and carried adequately segregated from other products whose temperature is sufficiently high to initiate a reaction of such cargo (see *Ch 1, 7.1 General 7.1.5.(d)*).

16.6.2 Heating coils in tanks carrying this product shall be blanked off or secured by equivalent means.

16.6.3 Heat-sensitive products shall not be carried in deck tanks, which are not insulated.

16.6.4 In order to avoid elevated temperatures, this cargo shall not be carried in deck tanks.

Summary of Minimum Requirements

LR 17.1 General

LR 17.1-01 The requirements of *Chapter 17 Summary of minimum requirements* of the IBC Code are to be adhered to.

List of Products to which the Code Does Not Apply

LR 18.1 General

LR 18.1-01 The requirements of *Chapter 18 List of products to which the Code does not Apply* of the IBC Code are to be adhered to.

Index of Products Carried in Bulk

LR 19.1 General

LR 19.1-01 The requirements of *Chapter 19 Index of Products Carried in Bulk* of the IBC Code are to be adhered to.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

Transport of Liquid Chemical Wastes

20.1 Preamble

20.1.1 Maritime transport of liquid chemical wastes could present a threat to human health and to the environment.

20.1.2 Liquid chemical wastes shall, therefore, be transported in accordance with relevant international conventions and recommendations and, in particular, where it concerns maritime transport in bulk, with the requirements of this Code.

20.2 Definitions

For the purpose of this chapter:

20.2.1 *Liquid chemical wastes* are substances, solutions or mixtures, offered for shipment, containing or contaminated with one or more constituents which are subject to the requirements of this Code and for which no direct use is envisaged but which are carried for dumping, incineration or other methods of disposal other than at sea.

20.2.2 *Transboundary movement* means maritime transport of wastes from an area under the national jurisdiction of one country to or through an area under the national jurisdiction of another country, or to or through an area not under the national jurisdiction of any country, provided at least two countries are concerned by the movement.

20.3 Applicability

20.3.1 The requirements of this chapter are applicable to the transboundary movement of liquid chemical wastes in bulk by seagoing ships and shall be considered in conjunction with all other requirements of this Code.

20.3.2 The requirements of this chapter do not apply to:

(a) wastes derived from shipboard operations which are covered by the requirements of *MARPOL - International Convention for the Prevention of Pollution from Ships*; and

(b) substances, solutions or mixtures containing or contaminated with radioactive materials which are subject to the applicable requirements for radioactive materials.

20.4 Permitted shipments

20.4.1 Transboundary movement of wastes is permitted to commence only when:

(a) notification has been sent by the competent authority of the country of origin, or by the generator or exporter through the channel of the competent authority of the country of origin, to the country of final destination; and

(b) the competent authority of the country of origin, having received the written consent of the country of final destination stating that the wastes will be safely incinerated or treated by other methods of disposal, has given authorization to the movement.

20.5 Documentation

20.5.1 In addition to the documentation specified in *Ch 1, 16.2 Cargo information* of this Code, ships engaged in transboundary movement of liquid chemical wastes shall carry on board a waste movement document issued by the competent authority of the country of origin.

20.6 Classification of liquid chemical wastes

20.6.1 For the purpose of the protection of the marine environment, all liquid chemical wastes transported in bulk shall be treated as Category X noxious liquid substances, irrespective of the actual evaluated category.

20.7 Carriage and handling of liquid chemical wastes

20.7.1 Liquid chemical wastes shall be carried in ships and cargo tanks in accordance with the minimum requirements for liquid chemical wastes specified in *chapter 17*, unless there are clear grounds indicating that the hazards of the wastes would warrant:

(a) carriage in accordance with the ship type 1 requirements; or

(b) any additional requirements of this Code applicable to the substance or, in the case of a mixture, its constituent presenting the predominant hazard.

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

Criteria for assigning carriage requirements for products subject to the IBC Code

21.1 Introduction

21.1.1 The following criteria are guidelines for the determination of pollution classification and assignment of appropriate carriage requirements for bulk liquid cargoes being considered as candidates for entry into the IBC Code or annexes 1, 3 or 4 of MEPC.2/Circs.

21.1.2 In developing such criteria, every effort has been made to follow the criteria and cut off points developed under the Global Harmonized System (GHS).

21.1.3 Although the criteria are intended to be closely defined in order to establish a uniform approach, it must be emphasized that these are guidelines only and, where human experience or other factors indicates the need for alternative arrangements, these shall always be taken into account. Where deviations from the criteria have been recognized, they shall be properly recorded with justifications.

21.2 Contents

21.2.1 This chapter contains the following:

(a) minimum safety and pollution criteria for products subject to *chapter 17* of the IBC Code;

(b) criteria used to assign the minimum carriage requirements for products, which meet the safety or pollution criteria to make them subject to *chapter 17* of the IBC Code;

(c) criteria used for special requirements in *chapter 15* of the IBC Code to be included in *column o* of *chapter 17* of the IBC Code;

(d) criteria used for special requirements in *chapter 16* of the IBC Code to be included in *column o* of *chapter 17* of the IBC Code; and

(e) definitions of properties used within this chapter.

21.3 Minimum safety and pollution criteria for products subject to chapter 17 of the IBC Code

21.3.1 Products are deemed to be hazardous and subject to *chapter 17* of the IBC Code if they meet one or more of the following criteria:

(a) inhalation LC_{50} ≤20 mg/l/4 h (see definitions in *Ch 1, 21.7 Definitions 21.7.1*);

(b) dermal LD_{50} ≤2000 mg/kg (see definitions in *Ch 1, 21.7 Definitions 21.7.1.(b)*);

(c) oral LD_{50} ≤2000 mg/kg (see definitions in *Ch 1, 21.7 Definitions 21.7.1.(c)*);

(d) toxic to mammals by prolonged exposure (see definitions in *Ch 1, 21.7 Definitions 21.7.2*);

(e) cause skin sensitization (see definitions in *Ch 1, 21.7 Definitions 21.7.3*);

(f) cause respiratory sensitization (see definitions in *Ch 1, 21.7 Definitions 21.7.4*);

(g) corrosive to skin (see definitions in *Ch 1, 21.7 Definitions 21.7.5*);

(h) have a Water Reactive Index (WRI) of ≥1 (see definitions in *Ch 1, 21.7 Definitions 21.7.6*);

(i) require inertion, inhibition, stabilization, temperature control or tank environmental control in order to prevent a hazardous reaction (see definitions in *Ch 1, 21.7 Definitions 21.7.10*);

(j) flash point <23°C; and have an explosive/flammability range (expressed as a percentage by volume in air) of ≥20%;

(k) autoignition temperature of ≤200°C; and

(l) classified as pollution category X or Y or meeting the criteria for rules 11 to 13 under *Ch 1, 21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code 21.4.5*.

21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code

21.4.1 ***Column a*** **- Product Name**

(a) The International Union of Pure and Applied Chemistry (IUPAC) name shall be used as far as possible but, where this is unnecessarily complex, then a technically correct and unambiguous alternative chemical name may be used.

21.4.2 ***Column b*** **- Deleted.**

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

21.4.3 ***Column c*** **- Pollution Category**

(a) *Column c* identifies the pollution category assigned to each product under *Annex II of MARPOL 73/78Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk* of MARPOL 73/78.

21.4.4 ***Column d*** **- Hazards**

(a) An "S" is assigned to *column d* if any of the safety criteria described in *Ch 1, 21.3 Minimum safety and pollution criteria for products subject to chapter 17 of the IBC Code 21.3.1* are met.

(b) A "P" is assigned to *column d* if the product meets the criteria for assigning Ship Type 1 to 3 as defined by rules 1 to 14 in *Ch 1, 21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code 21.4.5*.

21.4.5 ***Column e*** **- Ship Type**

(a) The basic criteria for assigning Ship Types based on the GESAMP Hazard Profile are shown in the table below. An explanation of the details in the columns is provided in appendix 1 of MARPOL *Annex II of MARPOL 73/78Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk*. Selected rules, identified in this table, are specified in *Ch 1, 21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code 21.4.5.(b)* for assigning specific Ship Types.

Rule Number	A1	A2	B1	B2	D3	E2	Ship Type
1			≥5				**1**
2	≥4	NR	4		CMRTNI		
3	≥4	NR			CMRTNI		**2**
4			4				
5	≥4		3				
6		NR	3				
7				≥1			
8						Fp	
9					CMRTNI	F	
10			≥2			S	
11	≥4						**3**
12		NR					
13			≥1				
14	All other category Y Substances						
15	All other category Z Substances All "Other Substances" (OS)						**NA**

(b) The Ship Type is assigned according to the following criteria:

(i) Ship Type 1:

- Inhalation LC_{50} ≤0.5 mg/l/4 h; and/or

  Dermal LD_{50} ≤50 mg/kg; and/or

  Oral LD_{50} ≤ 5 mg/kg; and/or

  Autoignition temperature ≤65°C; and/or

  Explosive range ≥50% v/v in air and the flash point <23°C; and/or

  Rules 1 or 2 of the table shown in *Ch 1, 21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code 21.4.5*

(ii) Ship Type 2:

- Inhalation LC_{50} >0.5mg//4 h - ≤2mg//4 h; and/or

  Dermal LD_{50} >50mg/kg - ≤ 1000 mg/kg; and/or

  OralLD_{50} >5mg/kg - ≤ 300 mg/kg; and/or

  WRI=2;

  Autoignition temperature ≤200°C; and/or

  Explosive range ≥40% v/v in air and the flash point <23°C; and/or

  Any of the rules 3 to 10 of the table shown in *Ch 1, 21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code 21.4.5*

(iii) Ship Type 3:

- Any of the minimum safety or pollution criteria for bulk liquid cargoes subject to *chapter 17* of the IBC Code not meeting the requirements for ship types 1 or 2 and not meeting rule 15 of the table shown in *Ch 1, 21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code 21.4.5*.

21.4.6 ***Column f*** **- Tank type**

(a) The tank type is assigned according to the following criteria:

Tank type 1G:	Inhalation LC_{50} ≤0.5 mg//4 h; and/or Dermal LD_{50} ≤ 200 mg/kg); and/or Autoignition temperature ≤65°C; and/or Explosive range ≥40% v/v in air and the flash point <23°C; and/or WRI=2
Tank type 2G:	Any of the minimum safety or pollution criteria for bulk liquid cargoes subject to *chapter 17* or the IBC Code not meeting the requirements for tank type 1G.

21.4.7 ***Column g*** **- Tank vents**

(a) The tank venting arrangements are assigned according to the following criteria:

(i) Controlled:

- Inhalation LC_{50} ≤ 10 mg//4 h; and/or

  Toxic to mammals by prolonged exposure; and/or

  Respiratory sensitizer; and/or

  Special carriage control needed; and/or

  Flash point ≤60°C

  Corrosive to skin (≤ 4 h exposure)

(ii) Open:

- Any of the minimum safety or pollution criteria for bulk liquid cargoes subject to *chapter 17* or the IBC Code not meeting the requirements for controlled tank vents.

21.4.8 ***Column h*** **- Tank environmental control**

(a) The Tank environmental control conditions are assigned according to the following criteria:

(i) Inert:

- Autoignition temperature ≤200°C; and/or

  Reacts with air to cause a hazard; and/or

  Explosive range ≥40% and the flash point <23°C.

(ii) Dry:

- WRI≥1

(iii) Pad:

- Only applies to specific products identified on a case by case basis.

(iv) Vent:

- Only applies to specific products identified on a case by case basis.

(v) No:

- Where the above criteria do not apply, (inerting requirements may be required under *SOLAS - International Convention for the Safety of Life at Sea*)

21.4.9 ***Column i* - Electrical equipment**

(a) If the flash point of the product is ≤ 60°C or the product is heated to within 15°C of its flash point then the electrical equipment required are assigned according to the following criteria, else '-' is assigned in column *i*' and *i*' '.

(i) ***Column i'* - Temperature class:**

- Autoignition temperature ≥ 450°C
- Autoignition temperature ≥ 300°C but < 450°C
- Autoignition temperature ≥ 200°C but < 300°C
- Autoignition temperature ≥ 135°C but < 200°C
- Autoignition temperature ≥ 100°C but < 135°C
- Autoignition temperature ≥ 85°C but < 100°C

(ii) ***Column i' '* - Apparatus group:**

Apparatus group	MESG at 20°C (mm)	MIC ratio product/methane
IIA	≥0.9	>0.8
IIB	>0.5 to <0.9	≥0.45 to ≤0.8
IIC	≤0.5	<0.45

- The tests shall be carried out in accordance with the procedures described in IEC 60079-1-1:2002 and IEC 79-3.
- For gases and vapours it is sufficient to make only one determination of either the Maximum Experimental Safe Gap (MESG) or the Minimum Igniting Current (MIC) provided that:

for Group IIA:	the MESG > 0.9 mm or the MIC ratio >0.9.
for Group IIB:	the MESG is ≥0.55 mm and ≤0.9 mm; or the MIC ratio is ≥0.5 and ≤0.8.
for Group IIC:	the MESG is < 0.5 mm or the MIC ratio is <0.45.

- It is necessary to determine both the MESG and the MIC ratio when:
- The MIC ratio determination only has been made, and the ratio is between 0.8 and 0.9, when an MESG determination will be required;
- The MIC ratio determination only has been made, and the ratio is between 0.45 and 0.5, when an MESG determination will be required;

  or

- The MESG only has been found, and is between 0.5 mm and 0.55 mm, when an MIC ratio determination will be required.

(iii) ***Column i' ' '* - Flash point:**

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

> 60 °C	:Yes
≤ 60 °C	:No
Non-flammable	:NF

Apparatus group	MESG at 20°C (mm)	Test media
IIA	0,9	Propane
IIB	0,65	Ethylene
IIC	0,28	Hydrogen

21.4.10 ***Column j*** **- Gauging**

(a) The type of gauging equipment permitted is assigned according to the following criteria:

Closed:	Inhalation $LC_{50} \leq 2$ mg//4hr; and/or
	Dermal $LD_{50} \leq 1000$ mg/kg; and/or
	Toxic to mammals by prolonged exposure; and/or
	Respiratory sensitizer; and/or
	Corrosive to skin (≤ 3 min exposure).
Restricted:	Inhalation LC_{50} >2 - ≤ 10 mg//4h; and/or
	Special carriage control indicates Inerting required; and/or
	Corrosive to skin (>3 min - ≤ 1 h exposure); and/or
	Flash point ≤60°C.
Open:	Any of the minimum safety or pollution criteria for bulk liquid cargoes subject to *chapter 17* or the IBC Code not meeting the requirements for closed or restricted gauging.

21.4.11 ***Column k*** **- Vapour detection**

(a) The type of vapour detection equipment required is determined by the following criteria:

Toxic (T):	:	Inhalation $LC_{50} \leq 10$ mg//4 h, and/or
		Respiratory sensitizer; and/or
		Toxic by prolonged exposure.
Flammable (F):	:	Flash point ≤60°C
No:	:	Where the above criteria do not apply.

21.4.12 ***Column l*** **- Fire protection equipment**

(a) The appropriate fire-fighting media are defined as being appropriate according to the following criteria related to the properties of the product:

Solubility >10% (>100000 mg/*l*)	:	A	Alcohol-resistant foam.
Solubility <10% (<100000 mg/*l*)	:	A	Alcohol-resistant foam; and/or
	:	B	Regular foam.
WRI = 0	:	C	Water spray (generally used as a coolant and can be used with A and/or B providing that the WRI=0).

WRI ≥1	:	D	Dry chemical.
No	:	No requirements under this Code.	

Note all appropriate media shall be listed.

21.4.13 ***Column m*** - Deleted.

21.4.14 ***Column n*** **- Emergency Equipment**

(a) The requirement to have personnel emergency equipment on board is identified by 'Yes' in *column n* according to the following criteria:

Inhalation LC_{50} ≤2 mg/l/4 h; and/or

Respiratory sensitizer; and/or

Corrosive to skin (≤ 3 min exposure); and/or

WRI=2

Note indicates that the above criteria do not apply.

21.5 Criteria for special requirements in chapter 17 to be included in *column o*

21.5.1 The assignment of special requirements in *column o* shall normally follow clear criteria based on the data supplied in the reporting form. Where it is considered appropriate to deviate from such criteria, this shall be clearly documented in such a way that it can easily be retrieved on demand.

21.5.2 The criteria for making reference to the special requirements identified in *chapters 15* and *16* are defined below with comments where relevant.

21.5.3 **Paragraphs 15.2 to 15.10 and 15.20**

21.5.3.1 *Ch 1, 15.2 Ammonium nitrate solution, (93% or less)* and *Ch 1, 15.20 Alkyl (C7 - C7) nitrates, all isomers* identify specific products by name with special carriage requirements that cannot be easily accommodated in any other way.

21.5.4 **Paragraph 15.11 - Acids**

21.5.4.1 *Ch 1, 15.11 Acids* applies to all acids unless they:

(a) are organic acids - when only paragraphs *Ch 1, 15.11 Acids 15.11.2* and *Ch 1, 15.11 Acids* apply; or
(b) do not evolve hydrogen - when *Ch 1, 15.11 Acids 15.11.5* need not apply.

21.5.5 **Paragraph 15.12 - Toxic products**

21.5.5.1 All of *Ch 1, 15.12 Toxic products* is added to *column o* according to the following criteria:

(a) Inhalation LC_{50} ≤2 mg/l/4 h; and/or

the product is a respiratory sensitizer; and/or

the product is toxic to mammals by prolonged exposure.

21.5.5.2 *Ch 1, 15.12 Toxic products 15.12.3* is added to *column o* according to the following criteria:

(a) Inhalation LC_{50} >2 - ≤10 mg/l/4 h; and/or

Dermal LD_{50} ≤1000 mg/kg; and/or

Oral LD_{50} ≤300 mg/kg.

21.5.5.3 *Ch 1, 15.12 Toxic products 15.12.4* is added to *column o* according to the following criterion:

Inhalation LC_{50} >2 - ≤10 mg/l/4 h.

21.5.6 **Paragraph 15.13 - Cargoes protected by additives**

21.5.6.1 The requirement to assign *Ch 1, 15.13 Cargoes protected by additives* to *column o* is based on the information related to the products tendency to polymerise, decompose, oxidise or undergo other chemical changes which may cause a hazard under normal carriage conditions and which would be prevented by the addition of appropriate additives.

21.5.7 **Paragraph 15.14 - Cargoes with a vapour pressure greater than atmospheric at 37.8°C**

21.5.7.1 The requirement to assign *Ch 1, 15.14 Cargoes with a vapour pressure greater than 1,013 bar absolute at 37,8°C* to *column o* is based on the following criterion:

(a) Boiling point ≤37.8°C

The Rules and Regulations for the Construction and Classification of Liquid Chemicals in Bulk

21.5.8 **Paragraph 15.16 - Cargo contamination**

21.5.8.1 *Ch 1, 15.16 Cargo contamination 15.16.1* is deleted.

21.5.8.2 *Ch 1, 15.16 Cargo contamination 15.16.2* is added to *column o* according to the following criterion:

WRI≥1

21.5.9 **Paragraph 15.17 - Increased ventilation requirements**

21.5.9.1 *Ch 1, 15.17 Increased ventilation requirements* shall be added to *column o* according to the following criteria:

Inhalation LC_{50} >0.5 - ≤2 mg/l/4 h; and/or

Respiratory sensitizer; and/or

Toxic to mammals by prolonged exposure; and/or

Corrosive to skin (≤1 h exposure time).

21.5.10 **Paragraph 15.18 - Special cargo pump-room requirements**

21.5.10.1 *Ch 1, 15.18 Special cargo pump-room requirements* shall be added to *column o* according to the following criterion:

Inhalation LC_{50} ≤0.5 mg/l/4 h

21.5.11 **Paragraph 15.19 - Overflow control**

21.5.11.1 *Ch 1, 15.19 Overflow control* shall be added to *column o* according to the following criteria:

Inhalation LC_{50} ≤2 mg/l/4 h; and/or

Dermal LD_{50} ≤1000 mg/kg; and/or

Oral LD_{50} ≤ 300 mg/kg; and/or

Respiratory sensitizer; and/or

Corrosive to skin (≤ 3 min exposure); and/or

Autoignition temperature ≤200°C; and/or

Explosive range ≥40% v/v in air and flash point <23°C; and/or

Classified as ship type 1 on pollution grounds.

21.5.11.2 Only *Ch 1, 15.19 Overflow control 15.19.6* shall apply if the product has any of the following properties:

Inhalation LC_{50} >2 mg/l/4h - ≤10 mg/l/4 h; and/or

Dermal LD50 > 1000 mg/kg - ≤ 2000 mg/kg; and/or

Oral LD_{50} > 300 mg/kg - ≤ 2000 mg/kg; and/or

Skin sensitizer; and/or

Corrosive to skin (> 3 min - ≤1 h exposure); and/or

Flash point ≤60°C; and/or

Classified as ship type 2 on pollution grounds; and/or

Pollution category X or Y.

21.5.12 **Paragraph 15.21 - Temperature sensors**

21.5.12.1 *Ch 1, 15.21 Temperature sensors* is added to *column o* according to the heat sensitivity of the product. This requirement is related to pumps in cargo pump rooms only.

21.6 Criteria for special requirements in chapter 16 to be included in *column o*

21.6.1 **Paragraphs 16.1 to 16.2.5 and 16.3 to 16.5**

(a) These apply to all cargoes and so are not referenced specifically in *column o*.

21.6.2 **Paragraph 16.2.6**

(a) *Ch 1, 16.2 Cargo information 16.2.6* is added to *column o* for products, which meet the following criteria:

Pollution Category X or Y and viscosity ≥50 mPa.s at 20°C

21.6.3 **Paragraph 16.2.9**

(a) *Ch 1, 16.2 Cargo information 16.2.9* is added to *column o* for products, which meet the following criterion:

Melting point ≥0°C.

21.6.4 **Paragraph 16.6 - Cargo not to be exposed to excessive heat**

(a) *Ch 1, 16.6 Cargoes not to be exposed to excessive heat 16.6.2* are added to *column o* for products, which are identified as requiring temperature control during carriage.

21.7 Definitions

21.7.1 **Acute mammalian toxicity**

(a) **Acutely toxic by inhalation**[7]

Inhalation toxicity (LC_{50})	
Hazard level	**mg//4 h**
High	≤0.5
Moderately high	>0.5 - ≤2
Moderate	>2 - ≤10
Slight	>10 - ≤20
Negligible	>20

(b) **Acutely toxic in contact with skin**

Dermal toxicity (LD_{50})	
Hazard Level	**mg/kg**
High	≤50
Moderately high	>50 - ≤200
Moderate	>200 - ≤1000
Slight	>1000 - ≤2000
Negligible	>2000

(c) **Acutely toxic if swallowed**

Oral toxicity (LD_{50})	
Hazard Level	**mg/kg**
High	≤5
Moderately high	>5 - ≤50
Moderate	>50 - ≤300
Slight	>300 - ≤2000
Negligible	>2000

21.7.2 **Toxic to mammals by prolonged exposure**

(a) A product is classified as *toxic by prolonged exposure* if it meets any of the following criteria: it is known to be, or suspected of being a carcinogen, mutagen, reprotoxic, neurotoxic, immunotoxic or exposure below the lethal dose is known to cause specific organ oriented systemic toxicity (TOST) or other related effects.

(b) Such effects may be identified from the GESAMP Hazard Profile of the product or other recognized sources of such information.

21.7.3 **Skin sensitization**

[7] All inhalation toxicity data are assumed to be associated with vapours and not mists or sprays, unless indicated otherwise.

(a) A product is classified as a *skin sensitizer*:

(i) if there is evidence in humans that the substance can induce sensitization by skin contact in a substantial number of persons; or

(ii) where there are positive results from an appropriate animal test.

(b) When an adjuvant type test method for skin sensitization is used, a response of at least 30% of the animals is considered as positive. For a non-adjuvant test method a response of at least 15% of the animals is considered positive.

(c) When a positive result is obtained from the Mouse Ear Swelling Test (MEST) or the Local Lymph Node Assay (LLNA), this may be sufficient to classify the product as a skin sensitizer.

21.7.4 **Respiratory sensitization**

(a) A product is classified as a *respiratory sensitizer*:

(i) if there is evidence in humans that the substance can induce specific respiratory hypersensitivity; and/or

(ii) where there are positive results from an appropriate animal test; and/or

(iii) where the product is identified as a skin sensitizer and there is no evidence to show that it is not a respiratory sensitizer.

21.7.5 **Corrosive to skin**[8]

Hazard Level	Exposure time to cause full thickness necrosis of skin	Observation time
Severely corrosive to skin	≤ 3 min	≤1 h
Highly corrosive to skin	> 3 min - ≤ 1 h	≤14 days
Moderately corrosive to skin	> 1 h - ≤ 4 h	≤14 days

21.7.6 **Water reactive substances**

(a) These are classified into three groups as follows:

Water reactive index (WRI)	Definition
2	Any chemical which, in contact with water, may produce a toxic, flammable or corrosive gas or aerosol.
1	Any chemical which, in contact with water, may generate heat or produce a non-toxic, non-flammable or non corrosive gas.
0	Any chemical which, in contact with water, would not undergo a reaction to justify a value of 1 or 2.

21.7.7 **Air reactive substances**

(a) Air reactive substances are products which react with air to cause a potentially hazardous situation, e.g. the formation of peroxides which may cause an explosive reaction.

21.7.8 **Electrical apparatus - Temperature Class** (for products which either have a flashpoint of ≤60°C or are heated to within 15°C of their flashpoint)

(a) The Temperature Class is defined by the International Electrotechnical Commission (IEC) as:

The highest temperature attained under practical conditions of operation within the rating of the apparatus (and recognized overloads, if any, associated therewith) by any part of any surface, the exposure of which to an explosive atmosphere may involve a risk.

(b) The Temperature Class of the electrical apparatus is assigned by selecting the Maximum Surface Temperature which is closest to, but less than, the product's autoignition temperature (see *Ch 1, 21.4 Criteria used to assign the minimum carriage requirements for products, which meet the minimum safety or pollution criteria to make them subject to chapter 17 of the IBC Code 21.4.7*).

[8] Products that are corrosive to skin are, for the purpose of assigning relevant carriage requirements, deemed to be corrosive by inhalation.

21.7.9 **Electrical apparatus - Apparatus group** (for products with a flashpoint of ≤60°C)

(a) This refers to intrinsically safe and associated electrical apparatus for explosive gas atmospheres which the IEC divide into the following groups:

Group I: for mines susceptible to firedamp (not used by IMO); and

Group II: for applications in other industries - further sub-divided according to its Maximum Experimental Safe Gap (MESG) and/or the Minimum Igniting Current (MIC) of the gas/vapour into groups IIA, IIB and IIC.

(b) This property cannot be determined from other data associated with the product; it has to be either measured or assigned by assimilation with related products in an homologous series.

21.7.10 **Special carriage control conditions**

(a) Special carriage control conditions refer to specific measures that need to be taken in order to either prevent a hazardous reaction. They include:

(i) **Inhibition:** the addition of a compound (usually organic) that retards or stops an undesired chemical reaction such as corrosion, oxidation or polymerization;

(ii) **Stabilization:** the addition of a substance (stabilizer) that tends to keep a compound, mixture or solution from changing its form or chemical nature. Such stabilizers may retard a reaction rate, preserve a chemical equilibrium, act as antioxidants, keep pigments and other components in emulsion form or prevent the particles in colloidal suspension from precipitating;

(iii) **Inertion:** the addition of a gas (usually nitrogen) in the ullage space of a tank that prevents the formation of a flammable cargo/air mixture;

(iv) **Temperature control:** the maintenance of a specific temperature range for the cargo in order to prevent a hazardous reaction or to keep the viscosity low enough to allow the product to be pumped; and

(v) **Padding and venting:** only applies to specific products identified on a case by case basis.

21.7.11 **Flammable cargoes**

(a) A cargo is defined as flammable according to the following criteria:

IBC Code descriptor	Flash point (degrees Centigrade)
Highly flammable	< 23
Flammable	≤ 60 but ≥ 23

(b) It should be noted that flash points of mixtures and aqueous solutions need to be measured unless all of the components are non-flammable.

(c) It should be noted that the carriage of bulk liquid cargoes which have a flash point of ≤60°C is subject to other *SOLAS - International Convention for the Safety of Life at Sea* regulations.

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